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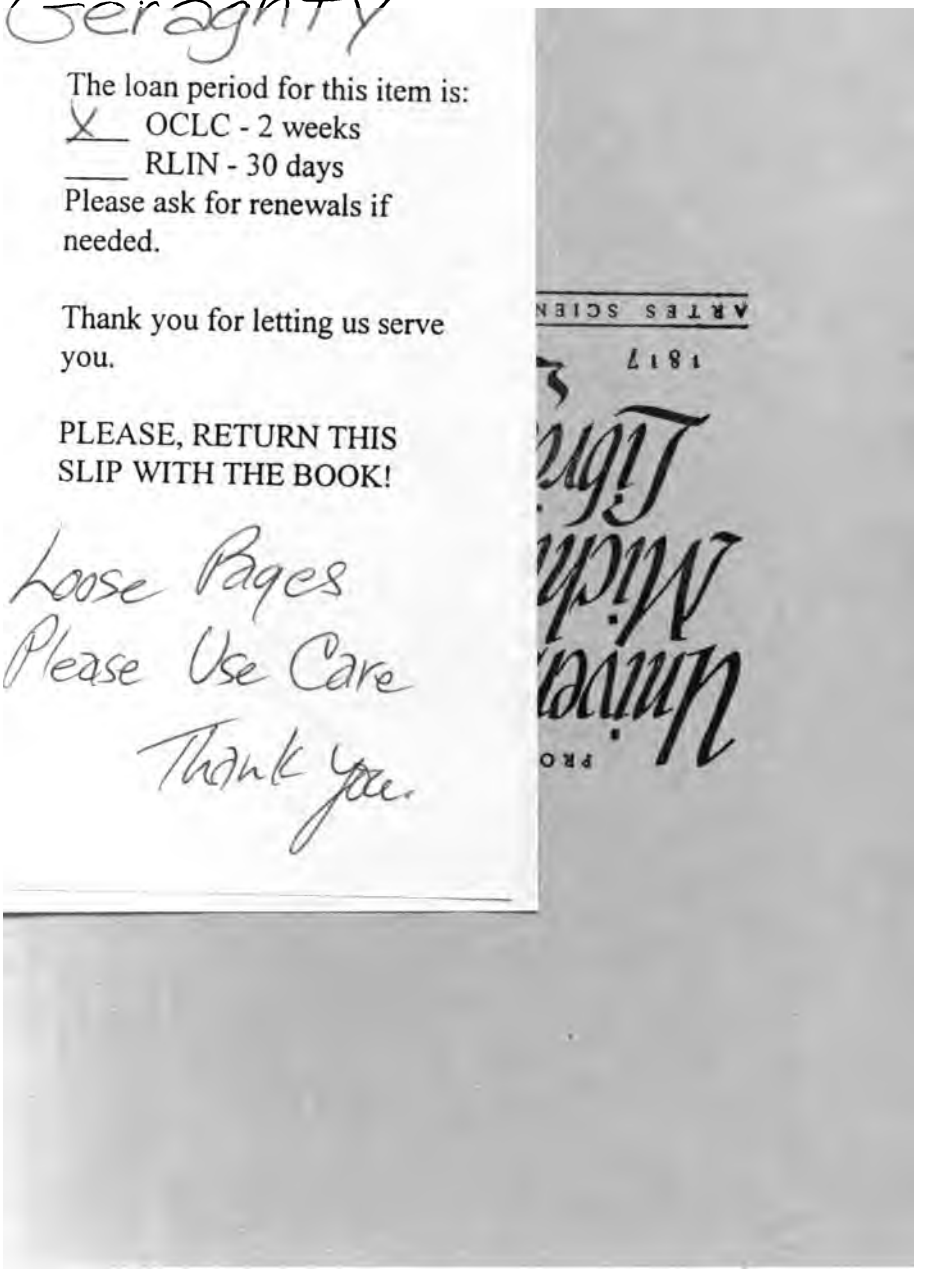

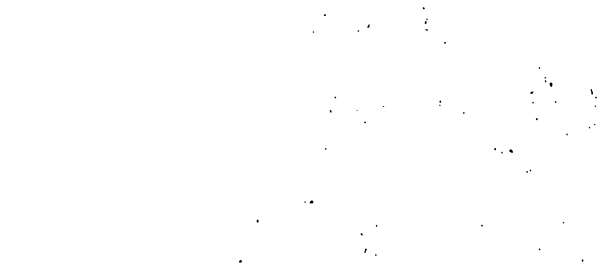

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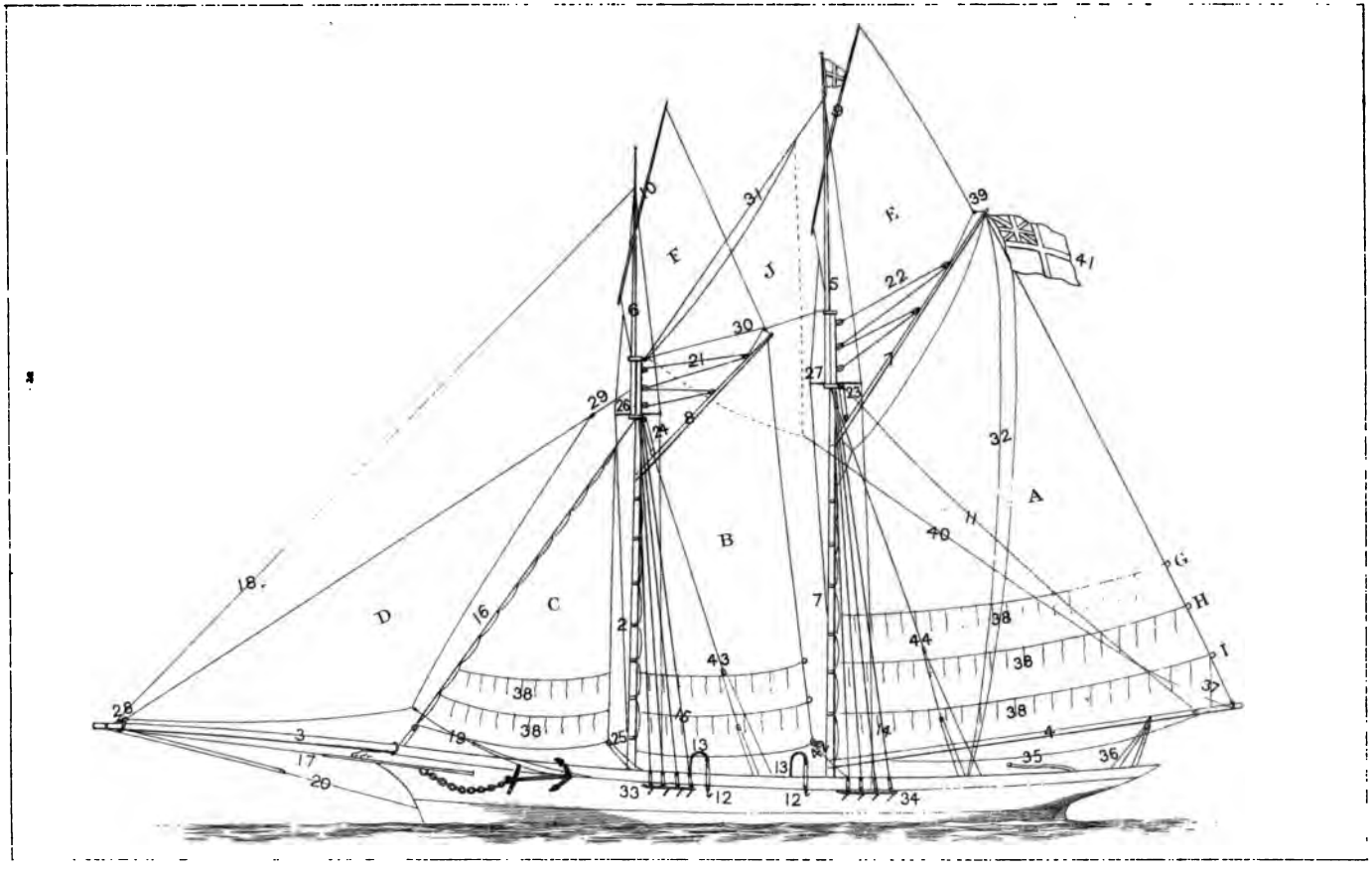

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A TREATISE

ON THE

CONSTRUCTION, RIGGING, & HANDLING

OF

MODEL YACHTS, SHIPS & STEAMERS,

WITH REMARKS ON

CRUISING & RACING YACHTS,

AND THE

MANAGEMENT OF OPEN BOATS;

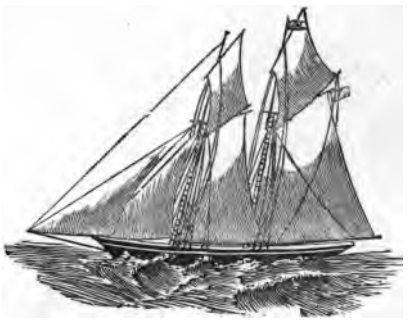
ALSO

LINES FOR VARIOUS MODELS AND A CUTTER YACHT.

By TYRREL E. BIDDLE.

Author of the "Corinthian Yachtsman, or Hints on Yachting."
"Hints to Beginners in Amateur Yacht Designing."

SECOND EDITION, ENLARGED.



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NORIE & WILSON,

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1883.

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"And first with nicest skill and art,
Perfect and finished in every part
A little model the Master wrought,
Which should be to the larger plan,
What the child is to the man."

LONGFELLOW.

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PREFACE TO THE SECOND EDITION.

In accordance with the kind suggestions of several of my Readers I have given the lines of a 2` feet 6 inches Yawl and a 3 feet Cutter, which I trust will soon be afloat and taking their part in a Model Yacht Regatta. With respect to the Design for a Racing Yacht on old Y. R. A. rule of measurement, I have replaced it with one on the new measurement.

Return 1-26-41 MPL

This has been necessitated by the alteration in the Yacht Racing Association rule of measurement. The rule, as it now stands, reads thus :—Length added to Breadth and multiplied by the same figures, then multiplied again by Breadth alone, and divided by 1730, the quotient is the tonnage. Although this rule does not very materially alter the tonnage of existing yachts, at the same time it gives a slightly fairer chance to the designer than the old mode of calculating the tonnage, inasmuch as length plays a more important part in increasing the nominal size than it did formerly. This being so, it becomes possible to build a vessel on less exaggerated dimensions for racing purposes, and which, while taking her part in sailing matches with fair success, will be found a handy and comfortable cruiser. The limited deck space and great draught of water of the modern 10-ton racer is greatly against them when wanted for cruising ; besides the number of hands required to work, say the *Buttercup* or *Neptune*, puts them out of the reach of those young yachtsmen who find one paid hand a serious item in their weekly expenditure. It may be said, and with some justice, that those who cannot afford to do the thing properly ought not to go in for yachting. At the same time there is much to be said on the other side, and it was certainly not the aim of the originators of sailing matches, to make yachting in 5 or 10 tonners such a costly amusement as to put the sport beyond the reach of those

who have to earn their livelihood at the desk or in the workshop. However, it is hardly likely that the new rule will have much effect in cheapening yachts while the price of lead and labour is kept up, so that the long purse will still have the best chance of carrying the day in yachting rivalry.

Some of the modern-built vessels come very near the dimensions and type of my craft, and as it has served its purpose it is no longer of any importance. The success which has attended *Louise*, *Buttercup*, and others has corroborated in a most marked manner all I alleged with respect to the influence of the then Yacht Racing Association Rule in favouring the elongated type of vessel illustrated in the design in question. The measurement question, however, is very far from being settled, and a new experiment is about to be tried by the Y. R. A. based on the length and area of canvas.

I must not forget to thank the author of another book on the same subject for the high compliment he has paid me in reproducing, with only slight variations, the major part of the matter contained in the *first edition* of "Model Yachting," which was the first work that ever appeared on this fascinating and scientific amusement.

LONDON, 1883.

"No ship that roams the ocean wide,
No bark that stems the rushing tide,
The daring Cutter can outvie;
When storms and adverse winds prevail,
Still closer draws her vent'rous sail,
In the wind's eye."—OLD SONG.

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INTRODUCTION.

MANY have been the sneers levelled at those who have taken to the pursuit of Miniature Yachting. It has been styled, trivial and ridiculous, and only fit for the amusement of children, but I very much doubt if any of those cavillers could either design, or build from draft a Model of a Yacht, mast, rig, and trim the same, so that it will beat to windward in the teeth of a fresh breeze, or fetch off a lee shore in a gale of wind. Those who have once mastered the rudiments of the art,—I say art and a very scientific art it is—have pronounced Model Yacht Sailing a most fascinating amusement, combining both pleasure and instruction. It requires no small amount of patience and perseverance to attain even a moderate amount of skill as a Model Yacht Sailor, and the designing and building of a craft which will show respectably in a match among the clippers which are turned out by some of the various Members of the Model Yacht Clubs, is by no means an easy task. As in real yachts so in models, the most successful builders are professionals, but here and there an amateur steps in and carries all before him for a season or two, but he soon finds imitators, for Model Yacht Sailors are far from being conservative with respect to their ideas, and the following season our successful friend probably finds himself beaten by a vessel on his own lines, *slightly improved.* I have heard more than one person with nautical proclivities, on being shown a successful Model Yacht, exclaim—"Oh, it's easy to make one to beat that thing, I have often cut out boats when I was a boy." And on the strength of that, he calls at a carpenter's shop on his way home, selects a block of wood, and gets the carpenter to shape it into a boat. This he finishes and rigs after the most approved toy shop fashion, pits it against the racing model, and to his astonishment and disgust finds that he cannot even make his craft sail on an indicated course, much less hold way with his despised competitor.

Perfection is never attainable in any art or science, but the enthusiastic Model Yachtsman, provided he goes the right way to work, may succeed in time in producing some very creditable specimens of miniature naval architecture, which will challenge comparison with the best turned out by professionals. Many hours of anxious thought and study must be spent, however, before the beginner has even a glimmering of the right way to go to work, and it is to save the would be model yacht designer all this trouble that this little book is written. No doubt it will be said by many professional model makers that we are interfering with their trade; this, however, has often been said before by tradesmen in relation to other pursuits, and it has generally been found that so far from any injury accruing to them from a more extended knowledge of the particular branch of business they represent, the contrary has been the case. Besides it is the interests of us all, inhabitants of this "tight little Island," to foster the nautical propensities of our British youth; and a correct knowledge of how to design and sail a model yacht is but the first step towards designing and owning a flying 100 ton Clipper, fit to go round the world in, and face the heaviest gale that ever blew.

With respect to the oft repeated opinion that "models can prove nothing," my experience extending over some 18 years, has been that they prove a great deal, and that many a pound would be saved by yacht owners if they would test their ideas by means of a model before going to the expense of building a real yacht. It must not be overlooked that all the improvements introduced in American yachts prior to the advent of the celebrated "America" in 1851 were found out from models altered and realtered until found to answer, and it has invariably followed that the vessel constructed in accordance with the experience so gained has been a success.

CHAPTER I.

DESIGNING.

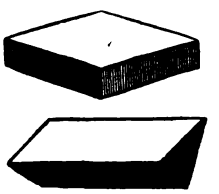
PRACTICE AND THEORY—KNOWN ELEMENTS OF SPEED—PROPORTIONS OF LENGTH, BREADTH AND DEPTH—FORM OF MIDSHIP SECTION—HOLLOW V. ROUND BOWS—LONG AND SHORT RUNS.

THERE are few subjects in which practice and theory are more divergent than in Model Yacht Building. The amateur, who is desirous of constructing a fast and reliable little craft on his first essay, must take care that he is not led away by the theoretical crochets of learned friends, from certain known and well-tried principles. A beginner should be satisfied at first with making a fairly good average model and learning thoroughly how to sail the same before attempting to rival Messrs. Froude or Reed in their peculiar ideas. Not that I wish to discourage experimental model making, but there are so many different things to be taken into consideration, in departing from what are supposed to be established principles, that it is safer for the beginner to feel his own way first. Time enough, when he becomes thoroughly master of the art, to try his hand at novelties in construction. Few who commence Model Yacht Building, theoretically, ever attain any marked success, and they generally give up the amusement in disgust when they find that all their time and trouble have been wasted in turning out a craft which is a failure in every sense of the word.

The first thing the would be Model Yachtsman has to consider, is the design of his craft from which to build. If, as is often the case, he is entirely ignorant of the principles which govern floating bodies, do not let him be discouraged on that account. I am not going to weary and puzzle the non-scientific reader by entering into a dissertation upon Naval Architecture in the style of either Rankine or J. Scott Russell. Those who wish for such information need not trouble themselves further with these pages. I shall merely, in as simple language as possible, explain certain rules which must be followed in designing a Model Yacht, so as to insure her being, while tolerably fast, a good sailer—a quality, the importance of which is self-evident when it is considered that models have to be steered artificially.

In designing a model it must be borne in mind that length gives speed. Beam or breadth gives stability or power of carrying sail,

while depth prevents the vessel from being forced sideways by the wind, in other words, enables her to sail close to the point from which the wind blows. The resistance which the water presents to the fore part or bow of a vessel is called "head resistance," and the resistance which the water makes to the side of a vessel is called "lateral resistance." Now it is obvious that to test the relative speed of different forms of boats, they ought to be of equal size, because size is a most important element in speed, and a model two feet long could not be expected to compete with one four feet long. It is therefore, necessary that some limit should be placed upon the size of boats intended for racing. In real yachting, rules of measurement known as tonnage laws, have been agreed to as the criterion of size, but in models it has been found simpler to merely limit the length, leaving the designer free as regards the other proportions of his craft. This being so, it naturally follows that his object is to gain as much speed as possible within a given length; and the designer has, therefore, to consider the proportions of beam and depth best calculated to accomplish this. From experiments I myself have carried out in conjunction with others, the amount of beam is regulated by the length to the extent of 4 to 1. That is to say, the breadth of the vessel in her broadest part should not exceed just one fourth of the length. Thus a model two feet long, a very safe size for a tyro to start upon, would have six inches beam. The depth should not exceed, without keel, two-thirds of the beam, or in a model of the above dimensions 4 inches. Such proportions are, of course, subject to certain modifications according to the fancy of the designer. Thus a ¼ of an inch less beam with a corresponding increase of the depth will give a very fair proportioned model, but the dimensions given above will be found the simplest for a novice in Model Yacht Building. Having determined therefore upon the dimensions of your craft, the next question is, what shall be the form of the midship section, or in other words, what shape shall the middle part of the vessel be supposing she were cut transversely across? Great diversity of opinion exists as to the best form of midship section. The midship section is to a great extent regulated by the form of the ends of a vessel. Thus a model with very hollow ends requires rather a full body to carry the weight necessary to enable her to stand up to her canvas. A model with full ends can have a finer or sharper midship section, because the extra buoyancy given her by the full ends enables her to carry her weight, comparatively speaking, without so much dependence on the midship body. This is more easily understood by the reader if he takes two pieces of wood, say three or four inches long, and squares them to an equal size. Then cut the ends of one away from the middle until it forms a diamond, thus; Now take the other piece and bevel the sides equally all along until it presents this appearance:



Placed in water it will be found that the two pieces of wood will sustain nearly an equal amount of weight. But bevel the sides of the diamond shaped piece away until it is like the other, and it will be found to carry only about two-thirds of the weight first put on it. This simple little experiment will show at once how much the form of the midship section is regulated by the form of the ends of a vessel. Having therefore determined upon the form of body, the designer must next consider how best to ease that body through the water. The fore part or bow of a vessel is called her "entrance" because that is the part with which she divides the water or pushes it aside while moving through it, and the run or latter part of a vessel is styled her "delivery" because the water after being separated by the bow passes along the body of the vessel, and meets again at the stern. Thus it becomes of the utmost importance that the water should be divided and delivered past the vessel in as easy a manner as possible. The resistance that the water meets with in its passage round a vessel will, of course, retard her speed, and therefore, the designer has to consider how to regulate and fashion his entrance and delivery in conformity with the midship section so as to reduce such resistance to the smallest possible limits.

It was thought by many that the problem was solved when Mr. J. Scott Russell propounded his celebrated "wave line" theory. I, however, would recommend a beginner to eschew the wave line for the reason that there are such an infinite variety of considerations which must be taken in connexion with the theory as to render it dangerous in inexperienced hands. Unless the wave line is very carefully applied it is sure to lead the Model Yachtsman into difficulties. On no account should the tyro in Model Yacht designing, as we have already observed, depart from the plain and simplest rudiments of the art. If he likes a hollow bow with rather a full midship section, or prefers a round bow with a fine body, he can have either without troubling himself much about the wave line or any other theory. Always bear in mind that a fine midship body with rather full ends is the steadiest sailing of all forms, although it is not so speedy as sharper ends with a fuller midship body. Care must be taken, however, not to sacrifice steadiness for the sake of a little extra speed. With respect to the former quality the run of a model has an important bearing upon it. If the after part of your model is decidedly bigger every way than the fore part, she will have an inclination to turn her bow away from the wind when pressed down on her side, or to speak nautically, she will carry "lee helm." This is a peculiarity very hard to deal with. It can certainly be cured, and the craft made to hold a good weatherly course, but at a sad loss of speed. The surest way is to make the run of the vessel almost identical in length to the bow. In fact, the two ends of your model ought, supposing she were divided in half amidships, to displace an equal amount of water, or in common phraseology, take an equal amount of weight to

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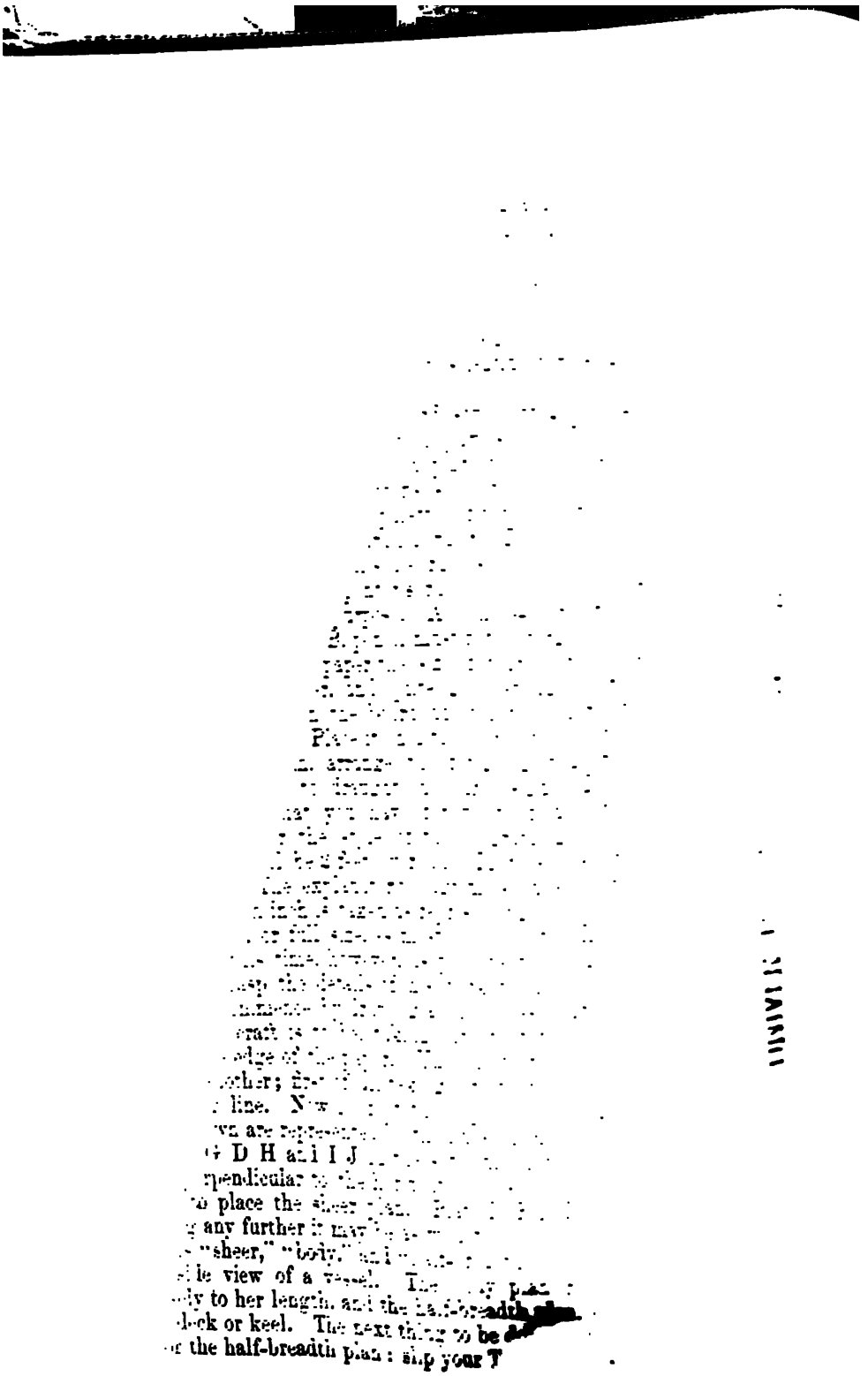


sink them. Some model makers advocate the bringing the run in to a mark thus — This, however, causes a serious loss of power to the after body without any corresponding advantage. Greater floatage can be retained with a longer delivery by curving the run into the dead wood, as in the annexed drawing.

Having given a sufficient explanation of the principles involved in designing a Model Yacht, I shall next proceed to show how the design determined upon can be draughted, or in non-technical language, placed on paper as a guide to the modeller in constructing his craft, because the Model Yachtsman requires a drawing to work from, the same as a real Yacht Builder. Neither could carry out a design without they possessed a good working drawing, and, therefore, in the next chapter we will devote our attention to what, in the vernacular of shipwrights is called "Draughting."

CHAPTER II.

DRAWING THE LINES.

To the Student of Naval Architecture fresh from the School at South Kensington much that I say on the subject of Draughting will doubtless appear crude and obsolete. With all due respect, however, to the wonderful technical knowledge picked up by these gentlemen, it is questionable whether their opinions are to be accepted as infallible. To the tyro in Model Yacht Building a long dissertation upon centres of gravity, displacement, wave motions, and angles of inclination couched in the highly scientific language of the modern school of Naval Architecture, would be useless and serve no other purpose than to puzzle and confuse. At the same time it is necessary that the aspirant for fame at miniature sailing matches should be able to lay off the lines of a vessel with tolerable accuracy, so that when he fixes on a design for his craft, he may have something tangible to work from, and not waste time and energy in hacking and hewing at a kindly grained pine log, under the impression that by so doing he can become a proficient Model Yacht Builder. There are various ways

of constructing models which I shall treat of further on, but they all, without exception, require that the lines should be first drawn out, or to use a more correct term, draughted. Without a carefully prepared drawing, even a block model, or to use the vernacular of the model dockyard "a dug out" cannot be truthfully made. In explaining the *modus operandi* of laying down a design upon paper, I shall avoid as much as possible the use of scientific terms and phrases for the reason already stated.

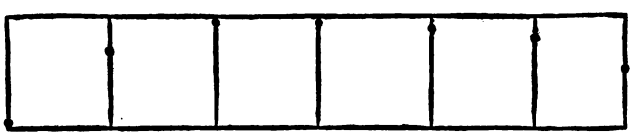
The first step is to provide a drawing board, say about 26 by 20 inches, this will be large enough for all practical purposes. A box of drawing pins, a straight-edge, a T square, a pair of compasses, a couple of crowquills, two or three long battens, some wooden moulds (thin pieces of wood like an artist's colour palette) of various curves, a drawing or bow pen, and a very long parallel ruler. These will be sufficient to begin with. A mathematical scale rule is also useful, but it is not indispensable, an ordinary carpenter's rule, divided into sixteenths of an inch, answering every purpose. A camel's-hair brush, and a cake of Indian ink, with an H.B. pencil must not be forgotten.

Next obtain a sheet of cartridge paper the size of your board, it is less expensive than drawing paper, and quite good enough for a working plan, stretch the paper on the board, and pin it down round the edges with the drawing pins. Place it on a table or bench so that you have plenty of elbow room, arrange the foregoing materials within easy reach, and proceed to draught in your design. I will assume for the time being that you have for want of a better, determined upon a craft after the style of the diagram given in Plate I., and decided she shall be 2 feet over all. In this case the drawing may be full size. The explanatory diagram is on a quarter scale, that is, a quarter of an inch is taken as representing 1 inch. A design can be half, quarter, or full size, as most convenient. Let us take a full size drawing this time, however, as perhaps the beginner will be better able to grasp the details of his work than if it were upon a smaller scale. Commence by drawing a line across your paper exactly the length your craft is to be, taking care that the line is exactly parallel with the edge of the paper. Underneath this, exactly 1 inch below it, draw another; first of all taking care that your ruler is parallel to the other line. Now look at the explanatory diagram. The lines you have drawn are represented by the lines, A E and B F, Fig. 1. Rule off C G D H and I J in the same manner, then rule a line at each end perpendicular to the horizontal lines, and you have the square wherein to place the sheer plan. Plate I., Fig. I. of your craft. Before going any further it may be as well to explain what are meant by the terms "sheer," "body," and "half-breadth" plans. The sheer plan is a side view of a vessel. The body plan represents sections transversely to her length, and the half-breadth plan, sections parallel with the deck or keel. The next thing to be done is to mark out the square for the half-breadth plan: slip your T square down the

board, and draw another line from A^2 to B^2. Fig. 2, plate I., this marks the middle line of the deck. Then with the compasses measure off on your rule the exact beam your vessel is to be, and take half in the diagram we are working upon, this is ascertained to be three-quarters of an inch, and therefore the full size would be 3 inches. At that distance draw another line parallel to A^2 and B^2 this is shown by the line C^2 and D^2, then draw lines perpendicular to the two horizontal lines A^2 and C^2, and B^2 and D^2, and you have the square in which to draw the half-breadth plan. Last, but not by any means least, comes the square for the body plan: measure the exact beam and mark it on the paper, draw a line C^3 and D^3. With the compasses measure on the scale the full depth, in Plate I. it is exactly 1 inch, and therefore it would be full size 4 inches. From the line C^3 and D^3 draw another line A^3 and B^3, taking care that it is exactly parallel to the other; then from D^3 to B^3 draw a perpendicular line, and from C^3 to A^3, another and you have the square in which to lay off your body plan. All this may seem to the practical draughtsman sheer waste of time, but as I am not writing for the edification of those "who know all about it," but simply for the tyro in Model Yacht Building, I think it necessary to commence at the very beginning, because the novice in draughting is far less likely to err in drawing his sections with his body, sheer, and half-breadth plans squared accurately, than if he attempted to draw in his lines in the ordinary way. But "to return to our muttons," as the French say. Take up the rule again and mark the perpendicular lines 1, 2, 3, 4, 5, 6, 7; in Fig. 1, these are the mould sections, that is, supposing your vessel to be building, the places where the moulds would be, of which more hereafter. In a model 2 feet long these mould sections would be three inches apart. Of course the more sections there are, the more accurate will the lines be, but the number in the diagram are sufficient for all practical purposes, and the less complicated the design, the easier it will be for the tyro to comprehend it. On Fig. 2, rule with the pencil perpendicular lines at the same distance apart as in Fig. 1, and number them the same. In the body plan, Fig. 3, draw the lines B, F, G, C, and H, D, at the distance of one inch apart, take the compasses, and mark the exact centre of Fig. 3 (the body plan) and draw the lines K, L. Now lay aside your pencil for a minute and go carefully over the whole plan with the compasses, T square, and parallel ruler, if any of the lines are out of the parallel or perpendicular, even to a hair's breadth, correct them at once, or your design will not be true. Few model-makers pay sufficient attention to this. "Oh, that's near enough. I'll make it all right when I come to mark it off on the wood," is the usual rejoinder, to anyone venturing to point out a slight inaccuracy to the confident Model Yacht Builder. My advice to all readers of this little book is, never trust to being able to rectify errors in the design when marking off on the wood, don't grudge a little extra time over the draughting of your craft on paper, it will save you endless

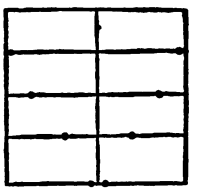
trouble in the end. How many nice pieces of pine plank, I myself have spoiled through a simple and to all appearance easily rectified error in the drawing. Therefore, I say, spoil a dozen sheets of paper rather than risk having your model in the slightest degree untrue.

Let us suppose therefore that the critical examination to which the drawing has been subjected fails to discover any error, then the designer may at once proceed to draw in the lines proper of his vessel. What he has already accomplished is mere preparatory work. Take the pencil and a batten. Place the latter on your half breadth plan, and bend it until you obtain the exact curve your fancy dictates for a deck line, put pieces of lead cast into little blocks about two inches square at each end of the batten to keep it in its place, and rule off the line so formed. In the explanation diagram, Plate I, Fig. 2, the line A E is the deck line. If you have no particular fancy of your own with regard to the curve of the deck line, you cannot do better than copy the diagram. To lay this off correctly on the enlarged drawing take the compasses, and opening them out place the point of one leg on the line 1, Fig. 2, where it joins the line A^2 and B^2, then place the other point on the line A E where it cuts line 1 ; then place the compasses on the scale rule, and you will see that the distance between the line A^2 and B^2 and the line A E at line 1 is $^5/_{16}$ of an inch, this multiplied by 4 will give you $1\frac{1}{4}$, the distance it will be on the full size working drawing. Spread the compasses out to that extent therefore, and placing one point on the corresponding line to A^2 B^2 Fig. 2 on the explanatory diagram, place the other point on the line 1, and where it touches make a dot with your pencil. Proceed in the same manner with lines 2, 3, 4, 5, 6 and 7, and the line from B^2 to D^2; taking care to multiply all the distances by 4 for the enlarged drawing. Your half breadth plan will then have a series of dots on it thus—



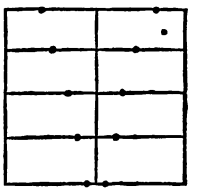
Take the batten and curve it so that it cuts all the dots, run your pencil round it, and the line so drawn will be an exact representation on an enlarged scale of the line A E Fig. 2, in plate I. Having thus drawn the deck line, the next thing is to draw the midship section, and here again the compasses must be brought into requisition. On the square of body plan, Fig. 3 Plate I, measure off with the compasses the distance the line 4 on both sides is from the lines B^3 D^3 and A^3 and C^3 where the cross line B F cuts it. It will be seen that there is no perceptible difference. On the next cross line, however, G C, the distance is $\frac{1}{8}$ of an inch, this multiplied by 4 gives $\frac{1}{2}$ an inch for your full size drawing. Open the compasses, therefore, to half an inch, and place a dot on the line in the enlarged body plan corresponding to the line G C

in the body plan (Fig. 3) in the explanatory diagram. Do the same with the lines H D and A^3 B^3 Fig. 3 measuring off the distance the line 4 on both sides is from the lines D^3 B^3 and C^3 A^3. You will then have a series of dots thus— in the square of body plan. With the batten make a curve taking in the dots, and run the pencil round it, and you have on your enlarged drawing an exact representation of the midship section in the body plan, Fig. 3, Plate I. Now we have got both midship section and deck line, but much yet remains to be done. So far the square of sheer plan, Fig. 1, has not been touched, but we will proceed to determine the amount of overhang or counter to give our craft. Open the compasses and measure the distance from E to 8 Fig. 1, Plate I., multiply it by 4 and mark it on your enlarged drawing; then measure the distance from E to 8 where the line F B cuts it, mark this also on your drawing in the same way, this will give you the length and depth of your counter or overhang. Next take your compasses and measure off the distance from I to X, and dot it on your enlarged sheer plan. With your straight edge, rule a line from line 8 where it cuts the line F B to X, this will give you the rake of stern post. Always bearing in mind that whatever distances you measure off on the explanatory diagram must be multiplied by 4 for your enlarged drawing. As yet the operation of draughting has not seemed a very difficult task, and indeed, after the tyro in Model Yacht Building has made a clean copy of lines according to these directions, it will not be long before he is able to design a craft on his own ideas. I remember, some years ago, showing a lad fresh from boarding school, the lines of a Model Yacht I was about building. Turning the drawing about he asked, "Would you explain to me the way to do this?" "Certainly," was my reply, and in similar language to that I have used in the foregoing pages, I explained to him the *modus operandi*. Some short time afterwards he called on me with a roll of drawing paper in his hand, and spreading it out on the table showed me the lines of a craft very like my own design which he had copied as well as he could from memory. We went carefully over the measurements together with highly satisfactory results to my young friend, for I could not detect a single error. That same youth, now a man, has since become most successful in Model Yacht Building and Sailing. But to return to our work. The reader will perceive that there are other lines of various curves on both the body and half breadth plans besides those he has already placed on his enlarged drawing. Those on the half breadth plan, Fig. 2, are water lines, those on Fig. 3 (the body plan), mould sections. A glance at the diagram will also show that one half of the body plan gives the sections of the fore body; and the other half, sections of the after body.



The designer will please take up his compasses again, and measure the distance the line B is from line A on Fig. 2, where the cross

section 1 cuts it, and mark it on the enlarged drawing in the manner already described, do this at the cross sections 2, 3, 4, 5, 6, 7 and 8, dotting the measurements as explained before. Now take the long batten, and adjust it with the leaden weights until it cuts all the dots and rule off. Do the same with lines C and D, and you have the water-lines of your craft. When you come to a design of your own the water-lines must be put in according as your fancy may suggest correcting them from the section or body plan afterwards. The tyro will comprehend this part of his work better after he has put in his mould sections. To do this the designer must again have recourse to his compasses, and carefully measure the distance from the line A^2 and B^2 (Fig. 2) to the deck line A at cross section 1, and mark it off on the body plan (Fig. 3). Do this with the water-lines at the cross sections 1, 2 and 3, and dot them off thus—



on the forepart of the body plan, rule them off, and your bow moulds are formed, cross section 4 being the midship section is of course the same on both sides, proceed in like manner with the cross sections 5, 6 and 7. This will give you the stern and after moulds of your vessel. In ruling the lines, care must be taken that they are fair with each other, after a little practice the eye will soon detect an unfair line. With the body and half-breadth plans lined off in this manner, the principal part of the design is completed, and it only remains to determine the amount of sheer. In the diagram we have been copying this is $\frac{1}{3}$ of an inch. Place your batten along the line A E in the sheer plan (Fig. 1) and draw it down in the middle $\frac{1}{3}$ of an inch, then rule off the curve so formed, and this will give the sheer line; this sheer line is dotted off in the body plan, and will explain itself. Next, to determine the amount of round to give the lower part of the stem, or to speak more correctly, the forefoot of the vessel. In the diagram it is $\frac{1}{2}$ an inch. Measure $\frac{1}{2}$ an inch in from J in the sheer plan, take a curve, and rule off to line D, this gives a very pretty round to the forefoot, but you can give her more or less as fancy dictates, always remembering that the rounder the forefoot, the faster a vessel will reach through the water. There are other lines called Buttock and Futtock lines, the uses of which will be explained further on. To the novice in designing they would appear rather confusing, so I have made this first lesson in drawing the lines of a boat as simple as I could. When the would-be Model Yacht Builder has become *au fait* at drawing water lines and mould sections, then he must turn his attention to the Buttock and Futtock lines, for it is upon the fairness of these that the speed of a craft depends, and when the Model Yachtsman begins to design for himself, he will see at once the vast importance of having good Futtock and Buttock lines.

The reader will notice that the lead keel is also given in the diagram. The size of this of course depends upon the displacement

of the craft, and the way to determine this will be found under its proper head.

It may perhaps assist the beginner if he draws his lines in different colours. Thus, the water lines may be blue, the cross sections black, and the mould sections red. Should he alter his craft after she is built, the alterations might be put in, in yellow or green. Always make a clean tracing of a design when it is finished, so that in case the working drawing should be destroyed or lost, you have the tracing for future reference, I generally draw my lines in pencil, then go over them with the bow pen and Indian ink, as handling the drawing is apt to render the pencil marks indistinct in places.

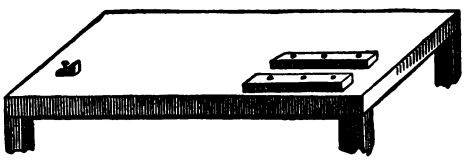
CHAPTER III.

CONSTRUCTION.

MATERIALS NECESSARY—HOW TO CHOOSE WOOD—THE EASIEST MANNER OF CONSTRUCTING A MODEL YACHT FROM A SCALE DRAUGHT.

IN order to construct a Model Yacht it will be easily understood that certain tools are necessary. What these tools are to be depends in a measure upon the pecuniary resources of the would be Model Yacht Builder. Should he be of an economical turn of mind and ingenious as well, he can make a few tools perform various duties. The only tools absolutely necessary are chisels, gouges, and spokeshaves. In addition it will facilitate the work if the amateur provides himself with a small axe, a good tenant saw, a key-hole saw, a smoothing plane, a coarse rasp, and a fine rasp. With respect to the chisels, two will be sufficient to begin with, one of which should be at least 1½ inches broad. The other may be half that size. Two gouges will also be useful, a quick gouge 1 inch broad, and a flatter one, which should be at least 1¼ inches broad. A stock and bits may also be added, hammers, screw drivers, gimlets, and brad-awls are generally to be found in every household. If there is a shed or empty room that can be utilised for a work-bench; I would recommend the amateur to rig up such a useful appendage at once, a second-hand carpenter's bench may sometimes be obtained very cheap. In lieu of one, however, the

following makeshift will answer the purpose. Get a common kitchen table (taking care that it is not one for which the good lady of the house has much regard) fasten it to the floor of the room or shed with wooden cleats or iron clamps. On the table nail two parallel pieces of wood 18 inches long by two square, at a distance apart of 7 or 8 inches. These should be placed so that the one is close to the edge of the table, thus:— the use of these will be explained presently. A piece of hard wood should also be nailed down, as is shown in the sketch, for planing against.

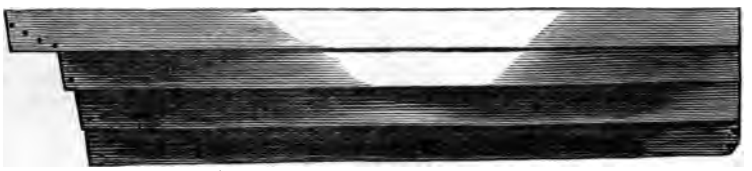


The next operation is to obtain suitable wood for your model. What this wood should be depends very much upon the manner in which the amateur is going to construct his craft. Should he be going to build, cedar or mahogany is best. If she is to be made in pieces, bread and butter fashion, Quebec yellow pine should be the stuff. Should the tyro determine to follow the toy shop method, and hew his Model Yacht out of a single block, then the best Baltic white fir should be obtained. There are other descriptions of wood such as spruce, larch, red pine, and Petersburg yellow pine, but they do not work up so well. Spruce is knotty, hard and heavy, red pine is troublesome to work from the tendency of the grain to rough up after being glassed and sand-papered. As to Petersburg yellow pine it is a poor substitute for Quebec wood of the same description, and ought only to be used when the other cannot be obtained. It will not do to overlook the merits of kawrie or New Zealand pine and North American white cedar. The former is easy to work, and takes a beautiful polish, it is, however, expensive, and not often found in an English timber yard. The latter is a magnificent wood for Model Yacht building, like kawrie it is very scarce, and consequently rather costly. In choosing wood, care must be taken that it is free from knots and shakes, that the grain runs straight and even, and that it is dry and well seasoned. There is no wood with which the amateur Model Yacht Builder is so likely to be taken in with, as Quebec yellow pine. Unless he is very sharp and careful, Petersburg or some other worthless stuff is likely to be palmed off upon him for Canadian pine. An infallible guide in the judging of yellow pine is its lightness. A cubic foot of Quebec yellow pine weighs only 25 lbs. Whereas a cubic foot of the other will bring down the scales to the tune of 37 lbs. The cheapest way of buying pine is by the plank. It generally runs 12 feet long, 3 inches thick, and 11 inches broad. It can also be obtained in balks of 5 × 5, 6 × 6, and 7 × 7 to 8, but these are generally cut from the imported timber log in England, whereas the plank is already cut when imported. This makes the balk rather dearer than the plank. The price varies very much in consequence of

the way in which the wood brokers rig the market. Probably 6d. to 8d. a foot per pine plank and 8d. to 9d. and 1s. a foot for balks would be about the average price. Quebec pine is not so good as it formerly was. Owing to the speculative tendencies of certain importers, anxious to make a fortune in the shortest possible time, the Canadian pine forests have been cleared in the most reckless manner. The trees, instead of being cut in the winter, when there is less sap in them than at any other period of the year, have been fell'd at all seasons, consequently the so called first quality bright pine, now brought to this country is about equal to the seconds of ten years ago. With respect to cedar and mahogany the tyro will be less likely to make a mistake, and the best Baltic white fir is easily recognisable from its fine straight grain and the whiteness of its cut. Another hint to the tyro, don't purchase your wood at a carpenter's shop, but go straight to a respectable timber yard, unless you are prepared to pay about one-third more than the price of the article.

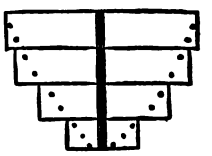
We will suppose that the wood has been purchased, and the tools carefully sharpened. Now, Mr. Tyro, what are your ideas with respect to the easiest way of constructing a Model Yacht from the lines you have just drawn out? You don't know; well then, let us examine into the various modes of Model Yacht Building. First of all, there is the building proper, in which you have to lay down the keel of your craft, and go to work in precisely the same manner as if you were going to construct a 5-tonner, instead of a model 2 feet over all. Then there is the hewing her out of a solid block, but this takes up more time than any other mode. Next comes the half-breadth plan of making a model; the two sides are made separately, and joined together longitudinally afterwards. This is held by some model makers to be the simplest way of all. Last, but not by any means least, comes the bread and butter mode, in which the wood is divided into thicknesses corresponding to the horizontal or water lines of the draught plan of the model. They are then laid one over the other like slices of bread and butter, hence the origin of the term. As this method of constructing a Model Yacht is that best adapted to teach a beginner how to carry out his design correctly I would advise the reader to commence his campaign with the tools by building his craft after the "bread and butter" fashion. A glance at the drawing will show that the horizontal or water lines on the sheer plan are 1 inch apart, therefore, the first thing to be done is to obtain four pieces of yellow pine the exact length and breadth of the vessel, and 1 inch thick. These should be very evenly planed and squared, so that when they are placed one on top of the other, they shall be perfectly true with each other. Now take your straight edge and rule a line exactly through the middle of each piece. Next take the compasses and measure the exact distance apart of each of the cross sections on the drawing, and mark them on the pieces of wood and rule them across, taking care that they are parallel to each

other, and at right angles to the midship line. So far so good. Now take the compasses again and measure on the drawing the exact places where the deck line cuts the cross lines, and mark it on one of the pieces of wood. Place the long batten in position and rule off the deck line on the wood. On the drawing you have only one side of the deck line drawn, but on the wood you will, of course, have both sides. This is easily done, by simply marking off with the compasses the point where the deck line cuts the cross lines on both sides of the middle, or midship line, of your wood. When this is done mark this piece of wood, No. 1, and put it aside. Take the next piece and measure off on it in the same manner the line marked B F in the drawing of the half-breadth plan. By this time the amateur Model Yacht Builder ought to be familiar with the use of his compasses and battens, so I will not presume any further upon his ignorance. After having, therefore, accurately marked the line B F on the piece of wood, he can number it 2, and put it on one side, while he proceeds to mark off upon the next piece the line G C of the half-breadth plan. This must be numbered 3. On the next piece the line C G must be marked off and the piece numbered 4. You have now the lines of your boat accurately marked off upon the four pieces of wood. The next operation is to saw them out. If you are living in the neighbourhood of a steam saw mills where they cut mouldings, &c., you can save yourself a lot of trouble and time by taking your wood there, and having it cut to the pencil marks in a few minutes while you wait, at a cost of about 6d.; should you, however, desire to saw them yourself, you must take care that the saw does not go *inside* the pencil lines. We will suppose, however, that the pieces are all accurately sawn round, either by yourself or at the saw-mills, now take some screws about 2 inches long, and after boring holes with your gimlet through the middle line of each piece, screw the whole together, beginning with the top piece and ending with No. 4. Your craft will now present this appearance, like a flight of steps.

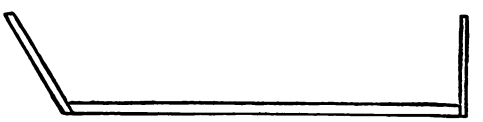


You must be careful when screwing together that the middle lines are exactly true with each other, or you will have no end of trouble. So far not much has been done, but had you commenced on a solid block your labour would have been treble what it has been to reach this stage. To resume, with your small saw take off the corners where you see the dotted lines in the stern of the sketch. Turn your craft bottom up and place her between the two pieces of wood, or chocks, as they are called, of your bench. To keep her in that

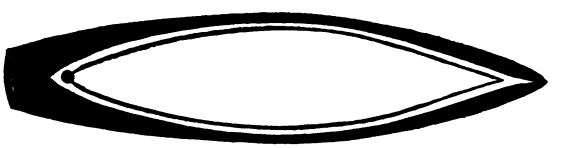
position while working at her, some strips of wood cut so as to form wedges, must be driven in between her sides and the chocks. Looked at end on the vessel forms this appearance.—



Now with a sharp chisel carefully cut off all the corners where you see the dotted line. Leave a ¼ of an inch each side of the middle of the bottom piece for the keel to go upon. The stem or stern post ought also to be left at least a ¼ of an inch thick for the present; with spokeshave and flat gouge go carefully into the hollows of the run or delivery, taking care that all the lines are brought fair into each other. A very good method is to cut out cardboard or zinc sections of the body plan, and by placing them in their proper positions along the sides of your craft, it is easy to judge whether you are working true or not. When you have got your vessel roughly into shape, take her out of the chocks, and put her on one side, while you make your stem, stern post, and wooden keel. Get a piece of ½ inch board, very truly planed so that it is perfectly straight, cut off a piece about ½ inch square and 2 feet long, tack it lightly down to your bench; then with your keyhole-saw cut out of hard wood, oak or elm, straight pieces ¼ of an inch square and 6 inches long, place them at each end of the piece of wood which you have put on the table at a distance apart, which will allow your boat to fit in between them, the after or stern piece will have to be raked in accordance with the rake of the stern post, thus:—



when you have got them exactly parallel and true with each other, take up your keel piece, and with a bradawl bore through each end, and into the upright pieces, with fine 3 inch brass screws, fasten the upright pieces to the wooden keel, so that they are perfectly true, then tack the keel lightly down to the table or bench again, place your craft between the two uprights, so that the middle line of her bottom piece is exactly true with them. You will now see that your stem or sternpost are true with each other. Now take the craft out and unscrew the pieces, turn the top piece bottom up and mark on it within a quarter of an inch of the edge, a line round it as in the sketch; with No. 2 piece do the same, and also with No. 3. Then with a large gimlet bore a hole where the black dot is, large enough to admit the keyhole-saw; saw the inside pieces carefully out, No. 4 piece of course will have to be scooped out with a gouge, but to the depth of ½ an inch only, as you want at least as much thickness remaining to hold the screws of the lead keel. With your quick and deep gouge go carefully



round the inside of each piece, so that it is the same thickness all over, which should certainly not be more than a ¼ of an inch. Do not be led away by the absurdity of supposing that ⅛ of an inch more or less can make no difference. Bear in mind that every ounce you take out of the inside of your boat means another ounce on the keel, where the weight is of most use.

Now screw the pieces lightly together at the ends, and place your craft again between the uprights to see whether the wood has warped, so as to throw either the stem or stern-post out of the true line. If she is at all out, then unscrew the pieces and examine them very carefully to see where the twist is. And if found to be a very slight warp, it may be restored by putting it under very heavy weights for a couple of hours. If, however, you have left good thicknesses of stem and stern-post, the simplest plan is to cut out the untrueness with the chisel, it is seldom more than 1/16 of an inch either way, and if the wood has been well seasoned there ought not to be any.

We have now arrived at a stage when we can sit down and contemplate our work for a while. If you are a smoker, light your pipe, sit down with the boat in one hand, and the drawing and card or zinc sections in the other, and study your work. Half-an-hour's quiet contemplation of this sort will soon show you any faults. Here it may be as well to give a hint with respect to handling chisels and gouges. A quiet, steady, careful manipulation of these tools will do far more work in a given time, than by a series of slap-dash, cut and come again attacks upon the wood, besides the risk which is run of spoiling your work by the reckless hacking and hewing which some people are so fond of. To resume, our next operation is to fasten our little craft together. For this purpose, get some "Elastic Glue" as sold at the gutta percha shops, (I have generally found that called the "Rock Marine Glue" the best); melt it in a tin-plate over a small spirit lamp, and with an old kitchen knife made hot, lay the glue on thick along each seam, hold the seams near a fire, if possible, while doing this, as the warmer the atmosphere the longer the glue will remain in a melting condition. Bring the edges of the seams together, and put in the screws at each end to insure the pieces fitting together truly. When the craft is in this condition lay her, bottom up, on the bench, and place some heavy weights along her keel. In about four to five hours she is fit for handling again. The two uprights may now be released from the table or bench, taken off the wood keel and nailed on with copper brads to the stem and stern-post. The wooden keel being dispensed with, as the model we have been working on requires no wooden keel between her lead and the bottom. As, no doubt, the reader thinks he has done sufficient work for the present, I will give him a rest, and leave the further development of the little craft to the next chapter.

CHAPTER IV.

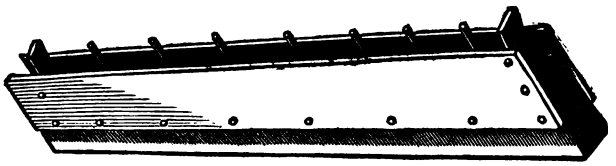
FINISHING.

LEAD AND IRON KEELS—HOW TO DETERMINE THE WEIGHT OF BALLAST—CASTING THE LEAD—FASTENING, DECKING, CAULKING, PAINTING AND BRONZING.

TWENTY years ago the notion of putting solid lead keels upon yachts was scouted as an impossibility. The idea of carrying the greater part of the ballast outside a vessel, even to this day, is regarded by some naval architects as wrong in principle, but there can be no doubt of the fact that the majority of old fashioned racing yachts have been vastly improved by having their ballast partly on the keel. Iron keels have been in vogue for more than half a century, but as iron is so much lighter than lead, the effect upon the stability of a vessel is not so great. Models require to have their ballast as low down as possible, and, therefore, the importance of a leaden keel is at once apparent. Iron keels are not much use. In the first place, unless you have a forge of your own, you must order your keel of a blacksmith, and, secondly, in order to get the necessary amount of weight to bring your craft down to a proper water-line the iron keel has to be made so large as to be very detrimental to her sailing qualities. In the United States iron keels are often seen on Model Yachts, but in England a Model Yacht Builder would stare if he were asked to put an iron keel upon a racing craft.

Before proceeding any farther with his model, the tyro must proceed to cast and fit her leaden keel; to do this he must first ascertain the exact amount of weight that she will take to bring her down to a proper water-line. Give the model, *inside* and *out*, a good coat of red or white lead paint. When this is dry, mark on the stem and stern post the place where you think she ought to swim to. Of course you cannot tell the exact trim of the boat until you have tried her under sail, but a very near approach to it may be made by the following simple rule:—Mark the centre of the bottom, the place where the keel goes on, and the centre of the length over all. Take the mean of the difference between the two, and mark it on the bottom *inside* the model. To explain this better, the model you are supposed to be making is 21 inches on the bottom, and over all 24 inches, the difference being 3 inches. The mean or half of the difference between these two measurements is, therefore, 22½ inches. Lay your rule along the top

of your model, and, measuring from the *stem*, make a mark at 22½ inches. The centre of this will be 11¼ inches; now make a mark on the bottom of your model, inside, 11¼ inches from the stem. Next place her in water, and, with weights placed exactly on the spot marked inside, ballast her down until she ceases to roll or rock from side to side when the weights are placed in her. The rocking motion is very slight indeed after she has been brought upright, but still there will be some, until, by the addition of more weight, she remains perfectly steady while it is being put in or taken out. With a pencil make a mark on the stem, side and stern where the water reaches her. Take out the model and just run a line round her with a batten, this will be pretty near her true trim. Of course, before taking the boat out, you must make a memorandum of the exact amount of weight put in her. With a model two feet long, put in first a 2 lb. weight, then a ½ lb., and so on, until you have got her right. A model like the explanatory diagram would take just 3 lb. 8 oz. of lead to bring her into proper trim. The next thing is to make the mould for the keel. Take a piece of half-inch board 2 feet long and 1 inch broad—see that it is exactly even and true. Lay it on the work bench, and cut out from ¼-inch board two pieces the same length, but 2 inches broad. Nail these on each side of the first named piece, so that it forms a trough 1½ inches deep. Measure the length of the place where the keel fits on, and block up the trough, to an equal length, with pieces of wood. Your mould is now ready for plugging, but it will be observed that in the diagram the keel is much deeper at the stern than at the bow, so with the plane slope off the upper sides of the trough, until it is only 1 inch deep at one end. Then make some wooden plugs a little larger than an ordinary 2 inch screw, and fix them in the trough exactly upright. The plugs at each end should be made a little smaller than the others, because the keel will have to be tapered away at stem and stern, as explained further on. The mould is now like the sketch, and is all ready for the lead.



In casting the lead a 4 lb. ladle should be used. This will be ample, as no properly constructed model 2 feet long ought to take more than 3¾ lbs. of ballast. Have a good clear fire not too fierce, place the ladle on it and wait until it is almost, but not quite, red hot. Then drop in the metal, taking care it is the best sheet lead, cut up so as to fit easily into the ladle. The mould must be placed level on the hearth and steadied by a couple of bricks, or anything heavy placed on each side of it. Now look into the ladle, and with an iron spoon carefully remove

any dross or dirt which you see collected on the surface of the molten metal. When the lead is thoroughly liquid, take the ladle carefully off, and with a steady hand pour the lead into the mould, beginning at the shallow end, and moving the ladle slowly along, until the mould is full. You must be careful that the metal flows easily round the wooden plugs or else the screw holes will be spoilt. Hullo! what's up? why the lead is seething and bubbling and at the same time gradually diminishing in the mould. Faugh! what a horrid smell of burning wool. Ah, my friend, you have left a little wee place in the side or end of the mould, through which, if you had held it up, you would have seen daylight. Never mind, not much harm done, out with the plugs and shake out what remains of the lead. Gather up the scattered metal, don't burn your fingers, use a pair of pincers, and replace it in the ladle, adding a little more to make up for waste. See what a great hole has been burnt in the side of the carpet, that was because you did not think of turning it back before beginning your Vulcanian labours. So this time be careful to have nothing in the way that can be spoilt by the molten lead. Replace the burnt wooden plugs by new ones and carefully stop with common putty (white lead does as well) any leaks in the mould, remelt the lead and pour as before. Ah, that is better, the mould fills up rapidly with a nice even surface. That will do, now leave it to cool. While the lead is cooling, we can be going on with the boat itself. At present she is in but a rough state, so go to work at her with glass paper, first of all taking off some of the more uneven roughnesses with the fine wood rasp. Use No. 3. of Oakey's Glass Paper for the first rub down, then No. 2, finishing with No. 1. Next cut out some strips of sheet zinc, brass, or copper if you have them will do as well. The strips should be about $\frac{1}{4}$ of an inch wide, and long enough to go round the boat inside. Lay them aside for the present, and take the keel out of the mould. This is best done by taking off one of the sides of the mould, when the keel can be lifted up without danger of bending or twisting it. Place your boat bottom up in the chocks on your bench, wedge her in lightly, remembering that she is only a light fragile thing now and not a solid mass. Place a layer of thick white lead and varnish along the place where the keel is to go; put on the keel, having first cleared the holes of the wooden plugs, and with a long bradawl bore into the boat sufficiently to take the screws. Be careful to see that the keel is true with the stem and stern post. Place in the screws and drive them home. By cutting round the holes in the bottom of the keel with a pointed knife, you will be able to counter sink your screws. When this is done your keel will present this appearance.

If there are projections they must be trimmed off with a knife, and the

keel rasped down smooth. The inside of the craft now requires a little attention. Take four of the zinc strips, and place them about 3 inches apart inside the vessel, bending them into the shape. Bore holes in them, so that they come between each seam, and one for the bottom, thus—

With ¼-inch fine brass screws fasten them to the sides and bottom of the model, give the whole a good coat of paint, and the inside is so far complete. Our next operation is to caulk the outside seams. They are already water-tight, thanks to the rock marine glue, but that is not sufficient; you will have observed, while using the glass paper, that the glue roughed-up and became sticky; so, with a knife, carefully scrape out a groove in the seams all round, and fill in with a little gold size putty (*see* appendix). This when dry, which will be in about one hour, can be rubbed down smooth, with No. 1 glass paper, and a coat of paint over all will cover up the seams, so that they are undistinguishable. While the paint is drying, the deck may be prepared. Get a nice piece of pine without knot or shake ⅛ of an inch thick. Picture frame makers generally have the best stuff for decks, and a piece big enough for a 2 feet model may be bought for about 4d. or 3d. One side of this should be planed smooth and well rubbed down with No. 0 glass paper. Mark off the deck line of the model on the wood, and with a sharp pen-knife cut it out. With the straight edge rule off a number of lines not more than ¼ of an inch apart, to represent the seams of the deck, give it a coat of varnish on *both sides*, and lay it aside to dry. While the model and deck are drying I may digress a little, in order to point out the importance of having a smooth, even surface. It has been ascertained by experiments, conducted under Admiralty supervision, that 50 per cent. or just one half of the force used in propelling a vessel through the water, is expended in overcoming what is technically called "skin resistance." The reader will have a better idea of the meaning of the term by placing a piece of French polished wood alongside a piece of common unpolished deal, at an angle say of 45 degrees, and letting a few drops of water run down each piece; it will be observed that the water runs off the polished wood without leaving a trail, or scarcely any, but on the unpolished there remain a considerable number of drops of water clinging as it were to the wood, or trickling slowly down. Now there is a certain stickiness in water, and the more uneven the surface that is placed in contact with it, the greater will be the inclination of the water to cling to that surface. Thus the advantages of a smooth, highly polished surface are at once apparent, and as it takes one half of the propelling power to overcome this clinging nature of the water, the Model Yachtsman should be careful that this is not added to, by roughness and irregularities of surface. I remember seeing a sailing match between two models that were considered nearly equal on every point of sailing. On one tack the model I will call B was quite equal

to A, but on the other tack A simply went two feet to the other's one. On examination, the cause was discovered on one side of B, the paint just at the water line was all roughed up into lumps and ridges. When it was the weather side it did not so much matter because it was lifted out of the water by the vessel heeling over, but on the other tack it was immersed. A rub down with glass paper there and then brought the two models on a par again on both tacks. A Model Yacht should have no uneven knobs, lumps, or dents, upon her surface—in fact the nearer approach you get to a coach panel the better your model will sail. Black lead makes a very slippery surface, but it is dirty and messy to work, besides requiring varnishing after it is put on, so that it is after all no better in that respect than copper bronze. To return to the little craft which is supposed to be under construction. When she is dry, which ought to be in 24 hours, proceed to put on the deck, first of all putting a couple of thin beams, ¼ of an inch deep across, about 3 inches apart, near the middle of the boat. These should be made a little higher in the middle than at the sides, so as to give the deck a slight rise amidships; this not only increases the air capacity of the boat, but looks pretty and yachtlike; use ¼ inch screws for the deck. Now cut the sheer your fancy dictates, and lay along the place where the deck goes, some white lead; screw down the bow end first, then each side at the middle, then the stern, and go gradually round, putting in screws about one inch apart. Bore carefully with a fine bradawl into the deck first, for fear of splitting before putting in the screws. The next job is to rub down again with glass paper, and, as the boat has now had two coats of paint, before a third is put on the Model Yacht Builder must ascertain how near she approaches the water-line marked on her before the keel was put on. On being placed in water it will be observed that she is much deeper than the mark. This is natural, for the deck, caulking, painting, &c., has all added to her weight. With the rough rasp take off some lead fore and aft until you get her back to the original water-line, now smooth the keel well over so that it is like a piece of glass. A piece of thin brass or zinc should be tacked along the bottom of the keel to preserve it from chafe from stones, &c. Now a little thin bit of cedar or pine may be nailed (with fine copper nails ½ an inch long) round the deck, if a gunwale or bulwark is desired. It should not be more than ¼ of an inch high at the most, as it holds both wind and water. Even then a couple of holes should be bored in the gunwale on each side, for scuppers to let the water run off. Now your craft is all ready for painting again, which should be done with red lead. When dry take some best japan gold size, and with a good brush, not too coarse, coat her over with it, to within an inch of the top of the gunwale. Wait for about 10 minutes until the size is tacky, and with a hare's foot or any very soft substance of the same nature go lightly over the size with copper bronze, brushing it on from right to left, not up and down. When dry, with a soft piece of chamois leather, polish it up, and the model will have a surface

almost good enough to shave by. The top side should be nicely gone over with black varnish, and when dry the whole boat, deck and all gone over with a coat of the best copal varnish. I think we will leave her now to another chapter.

CHAPTER V.

MASTING AND RIGGING.

How to Place the Masts—Dimensions of Spars—How to Make and Fit the Spars—Preparing the Cloth for Sails, Cutting and Sewing.

One of the most important points in connection with the rigging of a Model Yacht is the proper position of the mast or masts. In a cutter the position of the mast has a vast deal to do with the success or failure of the boat, and, to a less extent, in luggers and schooners also; therefore, great care must be exercised in masting your little craft. Any vessel, whether she is 2 feet long or 200, can be spoilt by the wrong placing of her masts. I had no idea how much the proper placing of the mast or masts had to do with the success of a boat until I had tried some experiments with models. It is astonishing what an almost infinitesimal alteration in the position of the masts will sometimes achieve. I remember having placed in my hands a 3 feet cutter, considered to be rather a fast boat of her size, having won several prizes. Thinking her mast was too far forward (it being $\frac{1}{3}$ of the length overall from the stem head) as she had rather a lean bow, I shifted it 1 inch further aft. Not only was the boat slower, but she was also very leewardly, and in strong winds carried lee helm. After trying to restore her to her original form, by various alterations in the sails and trim of the boat, without success, it suddenly occurred to me that the mast must have something to do with it. I shifted it back to its old place, and the boat was at once cured of all her tricks and was as fast and weatherly as when I first became possessed of her. By way of experiment I began shifting the mast aft again $\frac{1}{4}$ of an inch at a time, and each $\frac{1}{4}$ of an inch deteriorated the sailing of the boat, in fact she would only perform well under sail, with the mast exactly $\frac{1}{3}$ from the

stem head. It was many years ago when I was a mere novice at Model Yacht Sailing so that I never thought of investigating the "Whys" and "Wherefores" of the thing. Doubtless it was owing to some peculiarity in the lines of the boat. The best way for the amateur to find out the right position for his mast is by placing the model in a tank or pond, of course after she is ballasted down to her proper trim. Place a small screw amidships $\frac{1}{3}$ from the stem head. Tie a piece of string to it and take a turn with the string round another screw, placed square with the first on the edge of the gunwale, thus — Then keeping the end of the string in the hand push the boat

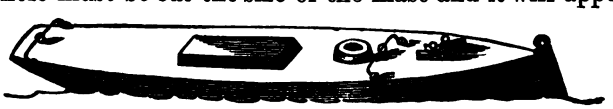
out as far as she will go, the length of the string ought not to be less than 5 or 6 yards. Wait until she is at rest, then tow her smartly along, walking at the same time, but without any jerks. Watch and see if she comes towards you with a long sweep or if she tows steadily, slacken the line and watch whether her head pays away from the shore, if it does, it is a sign you want the outside screw a little bit further aft. Shift it $\frac{1}{4}$ of an inch and try her again. If on the contrary she exhibits a strong tendency to come shorewards and will not keep the string taut, shift the outer screw $\frac{1}{4}$ of an inch further forward and then try her. When she tows along steadily without appearing to swerve either way, you can put a rule across her deck, exactly square with the position of the shifted screw, rule a line. Make a mark in the middle of it, and bore your mast hole in that place. The above is a very rough and ready way in finding out the position of a cutter's mast or a yawl's either. For schooners or luggers place four screws in the same way and make a span for the string. The position of the masts is ascertained by shifting the two side screws backwards and forwards, as has already been described. In luggers the foremast can be carried further forward than in a schooner, but as the lug rig is only useful for reaching and running I should advise the Model Yachtsman to eschew it, and confine his attention solely to the cutter, yawl or schooner.

Having found out the place for your mast, the next thing is to set about making a set of spars, and here it is as well to give a few hints with respect to their dimensions. The mast of a cutter should not exceed the length of the vessel, and its diameter should be about one-twelfth of the beam. Thus, in the model we are supposed to have been working upon, the mast would be two feet long and $\frac{1}{2}$ an inch diameter at its thickest part. I generally allow the bowsprit to be three times the beam of the boat; gaff, half the length of the keel; boom, half as long again as the gaff; topmast, same length as the hoist of the mainsail. These dimensions will give a very fair proportioned suit of sails. Very narrow vessels do not require quite so much spread as wider craft, so bowsprit, boom, and gaff must be shortened accordingly. No fixed rule can, however, be laid down for apportioning the exact amount of spread in proportion to beam, as so much depends upon the

form of the model. One hint I may give the Model Yachtsman, and that is never allow yourself to be led away into the belief that outrageously long spars and enormous sails will attain speed when close hauled. The ridiculous attempts which are often made, by those who know little or nothing of real yachting, to drive a badly formed model through the water by giving her a bowsprit longer than herself, a mast as long again, with a main boom projecting over the stern to the extent of half its length, only serve to excite the pity and contempt of the real Yacht Sailor, because he knows that the carrying capacity of a boat is limited, and if she will not sail fast with a fair proportioned suit of muslin, its a sign that the model itself is radically bad, and no amount of spars and calico will ever get an inch more out of her when sailing to windward. In reaching, some sailing machines, with enormous keels and correspondingly large sails, will go a great stick, but, like the "Flying Proas" of the Ladrone Islands, they are useless for any other purpose. The Proas referred to are flat on one side and round on the other; they carry one large sail, and are kept upright by means of an outrigger placed well over to windward. The speed of these craft with wind on the beam is said to be extraordinary, but they will not beat to windward or run before the wind, so for ordinary purposes they are valueless. The aim of the Model Yachtsman should be to assimilate his craft as much as possible to the real yacht, and as exaggeration in spars and canvas has never been found to answer in real yachting, so it generally fails in Model Yacht Sailing.

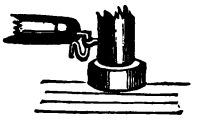
In making a spar choose a nice straight piece of either red, yellow, or white pine; ½ inch boards make capital spars for a 2 feet model. For a larger model ¾ of an inch or inch must be obtained. Pieces may be split off to the right length and squared afterwards, but the best and least wasteful way, is to have the board sawn into strips, the same width as the board is thick. And a 6 feet board ½ an inch thick by 11 inches broad can be cut up into ½ inch strips, at most saw mills at a cost of about 6d. Cut the strips off to the length required and with the smoothing plane take off the corners very evenly and carefully all the way along, this will be understood better from the cut. Next take the rasp and round the edges off. Finish off with plenty of glass paper beginning with No. 3 or 4 (coarse) ending with No. 0. (very fine.) This makes a very even spar. The bowsprit and boom should be about ⅓ and topmast and gaff ½ the thickness of the lower mast. It is advisable to make the bowsprit nearly the same thickness all the way, but the mast may be tapered slightly and the topmast and gaff also. The boom should be thickest in the middle as that is the part where the greatest strain comes, and as the fid holes are also most numerous in that part, it is necessary to have it pretty strong there. The mast-head should be in length about ½ the beam of the boat. Thus the model we have been constructing would have 3 inches mast-head. Some Model Yachtsmen prefer a shorter mast-head, but the topmast owing to its not having so much space between the

caps, is less firm and requires shrouds or backstays to make it stand properly, especially in a model 3 or 4 feet long where the strain on the topmast is something to be considered. The caps should be made large enough for the topmast to work up and down easily, and should be firmly secured to the mast-head. Wooden caps are sold at the toy shops from 6d. a piece upwards, but the Model Yachtsman can fit his mast-head himself and make a much neater job of it, as follows. Square the mast for 3 inches or more in proportion according to the size of your boat. Cut from sheet brass, zinc, or copper a couple of strips long enough to go round both mast and topmast, bore a hole in the brass each side of the mast-head and drive in a ¼ or ½ an inch brass screw. This makes a very strong job and it looks well besides not holding much wind. The sketch shows this mode of fitting the mast-head. The loop is a collar for the forestay to hook into so that the topmast can be housed, the same as in a real vessel without casting off the forestay. It is simply a piece of brass wire passed through a hole in the mast-head and the ends twisted together. Care must be taken in stepping the mast to see that it is perfectly upright or perpendicular with the stem and stern-post. It should be stepped with a *slight* rake so that when the forestay comes to be set up the mast will be upright, the strain on the forestay bringing it forward. Do not bore the step too deep, ¼ of an inch is plenty for a 2 feet model. To prevent leakage down the mast hole in the deck, a piece of cork cut round and glued on to the deck over the mast hole with rock marine glue, or elastic glue of any description as sold at the gutta percha shops, will answer very well. A hole must be cut the size of the mast and it will appear thus :



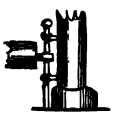
The bowsprit bitts should be made of hard wood, and screwed to the deck with small brass screws, as in the sketch. They should be placed about 5 inches in from the stem in a 2 feet model, and a little on one side, so as to clear the stem-head. A couple of screw eyes, which can be bought at most ironmongers at about 2d. a dozen, must be screwed into the top of the bitts, and a stout wire fid passed through them, takes a score cut in the top of the bowsprit near the inner end. When the bobstay is taut the bowsprit is firmly fixed in its place. Another score, cut about 4 inches further out on the bowsprit, is for taking the fid when the bowsprit is rigged in or reefed. A brass ring or *cranch*, as it is called in yachting phraseology, should be screwed down just alongside the stem, in a line with the bitts, for the bowsprit to reeve or pass through. If you like you can do away with the stem-head, and have the cranch ring in its place, and the bitts would have to be placed exactly on the middle line of the deck ; a stem-head looks neat, however, and gives a finished look to the boat, and the extra weight is not

worth a thought. The boom I generally work with a goose neck fitting in an eye screwed into the after part of the mast thus :—

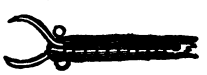


By having the wire for the goose neck twisted thus—

it cannot slip out of its place, although the boom is easily unshipped by turning it round after the sail is cast off from it. Some Model Yachtmen use three screw eyes, one on the boom and two on the mast, and drop a piece of stout wire through them into a small hole in the deck thus—



this is not so neat, however, as the other plan, and more trouble to make. The gaff should have hard wood or wire jaws. Wire are easiest made. All that has to be done is to bore a hole in the inner end of the gaff, about an inch from the end, and pass a piece of brass or copper wire through and bring the ends together. Then bind round gaff and wire with some very fine binding wire, which may be obtained, 1d. a hank, at most ironmongers shops. With a pair of pliers open out the ends and bend them round and your jaws are made.

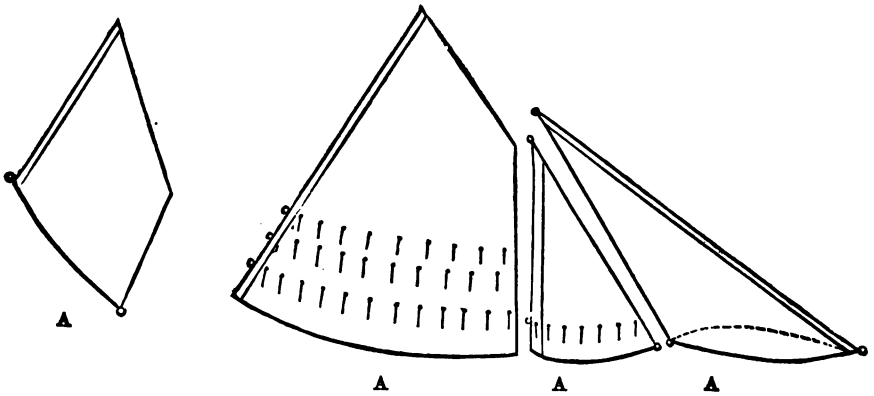


Wooden jaws are rather more trouble. Cut out two pieces of hard wood to this shape—

make the sides of your gaff flat where they are to go on, and pin them or screw them on with small $\frac{3}{8}$ brass screws. The topmast has a hole bored in its lower end, about $\frac{1}{2}$ to $\frac{3}{4}$ of an inch from the end for a wire fid to pass through ; this prevents it from slipping down when in its place. The topsail yards should be two in number, one short, the same length as the gaff, the other twice the length of the gaff. This last is for a balloon gaff topsail. Having finished the spars a coat of varnish should be given them, and while they are drying we will turn our attention to the stuff for sails.

Opinions differ as to the best material for making the sails of a Model Yacht. I have tried everything, from the commonest calico to the most expensive linen, and have generally found long cloth answer the best for lower sails, and jaconet muslin the best for balloon topsails, jibs, &c. Choose a nice close grained piece of long cloth, Horrocks' M. makes very good sails, so also does B. 2. About a yard will make the lower sails of a 2 feet model, $1\frac{1}{2}$ yard for a 2 feet 6 inch model, and about 2 yards for a 3 feet model. The price of good long cloth varies from about 9d. to 1s. 3d. a yard at different shops, but rather pay the higher price than take inferior stuff. By holding it up to the light defects are easily seen. If you see open patches where the threads appear wider apart than at the other places, with little breaks here and there, put it down and take up another piece. I will suppose that you have bought a capital piece of Horrocks' M ; now. The next thing is to prepare it for use. In its present state the cloth is unshrunk and will stretch amazingly. Clear off your work bench or table and put down a clean sheet of brown paper the size of the cloth. Have some boiling hot water ready, and dip the long cloth

into it 2 or 3 times, then rinse it well in cold spring water. Now spread it out on the table, of course over the paper and with some common tacks tack down one edge, then draw the cloth taut and tack down the opposite edge, and so on all round until it is as tight as the top of a drum; leave it so for about 24 hours. When it is dry it will be like a piece of veneer board, and you may do almost anything with it. The cloth will not shrink or stretch very much after it has gone through that process. Now the next thing is to cut out the sails. First of all lay the spars down on a large sheet of newspaper, and place them in position, then mark out paper patterns of all the sails and cut them out, taking care that all the edges are perfectly straight, with the exception of the foot of the sails. The sketch will show you best how



to do this—A is the foot of each sail, which, as you perceive is slightly curved. Unless this was done it would after a little use become curved the other way, and present a hollow foot, which is very unsightly. The dotted line in the jib shows where the hollow would come. Cut your sails rather high up in the foot so that they are well off the deck when bent and set. Nothing is so detrimental to a boat's speed as sails all down in the boat. A vessel will be actually stiffer and carry her canvas better if it is hoisted well up off the deck, than she will with the foot of the sails low down in the boat. I found this out when a youngster in an open boat. Not wanting to reef and the wind being rather fresh I lowered the sail down a bit, until the foot of the sail was down on the thwarts. The boat immediately buried down so much that we were in danger of being swamped, and it was only by hoisting the sail well up again that we could keep her going. The wind has a downward as well as a horizontal pressure, and that is the reason why the American fashion of lacing sails to the boom does not answer in heavy weather. I remember relieving a model cutter once from this downward drag and the effect was magical. Her mainsail was laced to the boom and she was being beaten every tack to windward. I took my penknife and ran it along the lacing, thus relieving the mainsail, the boat sprang

ahead directly as if some one had let go a line that was holding her back. I have heard from an Essex fisherman who tried a mainsail laced to the boom on his fishing boat, that it completely crippled her; said he, "they likes a little draught through 'em," meaning the mainsail of course.

Let us resume the thread of our "*discourse.*" Cut the sails, so that the after leach of the fore, main, and topsails is parallel with the selvage of the cloth. The jib should have the selvage along the head or luff. The double lines in the sketch represent the selvage. Do not take the cloth up all at once off the table, but lay the paper patterns on it, and, with a sharp pair of scissors cut round taking up as you go. Save about ¼ of an inch for the sewing. This requires great care; machine sewing may do very well when a sail is to be roped after, but, as the roping adds weight, and is not required, provided the sail is properly made, it is better to pay a little extra attention to the sewing. Machine sewing stretches the sail, more or less, out of shape; therefore, get your suit of muslin hand sewn, and let the threads be slightly drawn all round, not too much but just enough to prevent any waves of this description in the edge of the sail.

A sail ought to be as straight along the edges after it is sewn as it was before. Some Model Yachtsmen tape the edges of their sails—that is, sew tape all round them. This is not a bad plan, especially when the sail is made of very stretchy cloth; I prefer, however, plain hemmed edges. The head or luff of the jibs must of course be taped or roped after it is sewn, because the whole strain of the halyards comes upon that part, and it does not run on a stay like the foresail. The topsails, of which there ought to be three, one a jib-headed topsail (without a yard), must have the selvage along the after leach, where the double line is shown in the sketch of the sails.

Having now got our sails and spars already, the last operation is to bend them on and rig the little craft. This is a quiet evening's work, and, as there is no need of making any mess, the boat may be taken into the parlour, where we will leave her for the present.

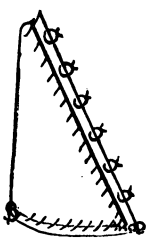
CHAPTER VI.

RIGGING A MODEL CUTTER.

Now that the Model Yachtsman has his spars and sails all ready, the next operation is to rig his boat; a great deal depends upon the way this is done. Most of the hand-books published by the Model Dockyards profess to teach the amateur the art of rigging, but unless the model is intended to be put under a glass case and exhibited as a specimen of complicated workmanship, the less attention the Model Yachtsman pays to such the better. In rigging a Model Yacht two principles must be kept in view. The first is simplicity and the second is lightness. When it is considered how very detrimental to speed is extra top hamper in a real vessel, it is easily understood how important it is that everything connected with the rigging of a miniature Clipper should be as light as possible. In fact, mast, spars, and gear should be just strong enough to stand the strain which will be put upon them and no more. How often do we see at Model Yacht races beautiful craft beaten by inferior ones, simply from the fact that the former are handicapped with a superfluous quantity of rigging, to say nothing of heavy spars, caps, crosstrees and other useless furniture. In a real yacht such things are a necessity, because the mast could not stand the strain put upon it without them, but with models it is different. Any model under four feet does not require more than one shroud on each side, and then only when the mast is weak. I prefer making my mast a wee bit stout where it enters the deck, and dispensing with shrouds altogether. Every extra bit of cord you put on your craft holds so much wind, and, when the vessel is close hauled, retards her speed, besides having a tendency to make her crank. It is astonishing how little our British youth know about these things; considering that we are a maritime nation it is surprising that English boys, as a rule, cannot tell the difference between a Cutter and a Schooner. In America it is different, and I was much struck, during a visit to the United States, by the wonderful knowledge displayed by youngsters of even 10 years of age, with respect to vessels of all classes. It would be hard to find an American lad sailing his boat in the lake on Boston Common or Prospect Park, who could not explain the meaning of weatherliness in a vessel, and the advantages and disadvantages of different rigs. The toy shop models in this country, with some exceptions, are rigged after the fashion of a bygone era. Spars projecting a fourth of their length beyond the sails, and the latter cut in a style that would give a modern sailmaker the horrors. I am of course not alluding to the regular

professional Model Yacht Builders, who construct for the Model Yacht Clubs, but to the craft seen in most toy shop windows. The modern racing yacht is as different in her rig from her prototype of thirty years ago, as the "America" Schooner was from the craft she came over to race against in 1851.

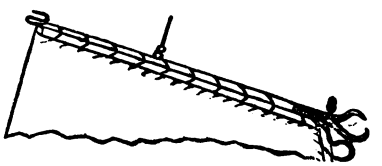
However, our business now is to bend the sails of the little Cutter turned off the stocks in the 4th chapter. We will begin with the foresail, in a Schooner this sail is called a forestay sail, see diagram of a Schooner, plate 2. With a fine pointed stilletto, such as is found in most ladies' work boxes, make a series of holes along the luff of the sail about 1 inch apart *in the hem.* Now take your *round* pliers and fine wire, put the wire through a hole and twist it into a little ring thus.— At each corner there should also be a little wire ring; the utility of these will appear hereafter. Now run a piece of whip-cord through the rings along the luff of the sail, and at the lower end of this whip-cord place a hook thus.— These hooks must be made of stoutish copper, or brass wire. With a needle and strong whitey-brown thread sew the two parts of the cord together as in the drawing. An eye splice looks best of course, but as it requires some skill to make one neatly the amateur had better content himself with the more simple operation of sewing an eye in the cord. Now step the mast, and screw into the stem of the model a small brass screw with an eye head, they can be bought, as I have already said, at most ironmongers for 2d. or 3d. per dozen. Hook the forestay in to this eye, and take the other end of it to the wire loop in the head of the mast, pass it through and haul it taut, so that the mast has a slight bend forward. Make a mark where the stay is nipped by the wire, and sew another eye, into which insert another wire hook. Your forestay will be then set up as in the diagram plate 3, figure 1. The tack of the foresail will have to be sewn into the lower eye of the stay, and a piece of fine rigging cord inserted and fastened in the head or upper clew of the sail; to the end of this cord attach a stout pin with an eye bent in its head thus.— Pass this pin through the wire loop in the head of the mast and haul taut, so that the luff of the sail is stretched fair and evenly without any creasing along the stay, and bore with a very fine bradawl a hole in the mast to take the pin. A study of the diagram already referred to will explain how to do this. Now for the foresail boom.



To the non-nautical mind booms on the head sails may not appear necessary, but a brief explanation will show their importance. A sail cannot be made to stand well unless the sail is stretched out taut along its foot as well as along the head and luff. In a real vessel the sheets of the head sails can be brought well aft for this purpose, but

in a model intended for racing, this cannot be done as too much time would be wasted in shifting the sheets from one side to the other. Every sail must be made to work itself, so the foot of the jib and foresail are extended on a small spar styled a boom, which keeps them flat while allowing the sails to blow clear of each other when the model is put about or jibed. The fore boom must be a nice round piece of pine a little longer than the foot of the sail. With your fine bradawl bore a hole in each end through which pass a piece of fine wire. Pass the wire into the clews of the sail and twist the ends up. A wire ring on the after part of the boom must not be forgotten. This is to reeve the foresheet through. The boom for the jib is placed differently. A spar about the same size as the foresail boom is made and into one end a pin is driven and bent thus.— Now bore a hole in the other end large enough to take fine rigging cord. With the pliers and stout wire make a traveller after this fashion.— Slip this on to the jib-boom, reeve a piece of rigging bored in the boom and fasten one end to the traveller, to the other end of the cord fasten a pin with an eye to it and your boom is complete. The jib should have a wire eye in each corner, or to speak more correctly, in each clew. The Model Yachtsman ought to be pretty familiar with the use of his pliers and wire by this time, and he ought not to find the making of wire eyes very difficult. Now for the fitting of the bowsprit. Make another traveller similar to the one for the jib-boom only large enough to slip easily along the bowsprit. Bore a hole in the outer end of that spar and reeve a cord, through which attach to the traveller, and fit with a pin as aforesaid. Screw into the outer butt of the bowsprit one of your small brass screw eyes. Take a piece of stout whip-cord and reeve through this for a bobstay. A strong hook must be fitted to the underneath part and a stout pin to the other. About one-third down the stem of your model you must have a bobstay shackle, these are variously fashioned, but the neatest way is to have a copper band about $\frac{1}{4}$ of an inch broad and 1 inch long, doubled round the stem and screwed in with $\frac{1}{8}$ of an inch brass screws. It should be allowed to project enough to take the hook of the bobstay, this is shown in the diagram plate 3. figure 1. Next we will bend the mainsail. Lay the gaff along the head of the sail, and sew it on with strong whitey-brown thread, taking care that the inner corner of the sail is close up to the jaws of the gaff. Then with pliers and wire make a series of rings along the part which goes next the mast; be careful that the rings are large enough to travel easily up and down the mast; these rings ought to be about $1\frac{1}{2}$ inches apart in a 2 feet model. See that each reef of the sail is in a line with a ring, screw into the outer end of the boom a series

of screw eyes corresponding with the number of reefs in your mainsail. About one-third from the outer end of the boom fasten a hard wood cleat. It only remains to attach the halyards, which ought to be of fine rigging cord, one the throat halyard fastened to the eye close to the jaws of the gaff, and the outer one the peak halyard, fastened about the middle of the gaff, and the mainsail is all ready for setting. The jib halyards are our next consideration; these should be long enough to bear doubling; one end fastened to an eye on one side of the mast-head, a wire hook slipped on, and then the other end passed down through an eye on the opposite side of the mast-head and attached to a pin; a couple of screw eyes should also be placed on the after side of the masthead for the throat and peak halyards to reeve through—one just under the lower cap, and another just under the upper cap. Next sew on the topsail yard to the topsail, bend on a piece of fine rigging cord for a halyard nearly in the middle of the yard, and a shorter piece to each clew. Attach pins to the end of all these cords or strings, if you like to call them so, and then proceed to set your sails. First slip the rings of the mainsail on the mast, then reeve the throat and peak halyards through the eyes in the mast-head, attach pins to the ends of the halyards, step the mast, slip the boom into its place on the mast, take a piece of fine rigging cord and fasten to the outer clew of the mainsail, pass one end through the outer brass eye on the boom, haul taut, and belay on the cleat. The lower ring of the mainsail, technically the tack of the sail, must be kept down by a pin, and then the throat and peak can be hoisted up, until the sail is fairly set; then hook on the forestay, reeve the halyards, and haul taut. Next ship the bowsprit, hook the bobstay into the shackle, haul it taut, and pin it down. A fine needle bradawl will be found of great assistance in boring for the pins. Haul the traveller on the bowsprit out to its limit, and slip the ring on the outer clew of the jib over the hook on the traveller, and the ring in the head of the sail on to the hook on the jib-halyards, hoist up the jib, and pin the halyards down. Now you will be able to see where to screw the brass eye, to take the goose neck of the jib-boom; this will probably be about one-fourth of the length of the bowsprit from the outer end. Slip the ring in the inner clew of the jib over the hook on the traveller, and then haul out and pin down, passing the pin through the eye in the end of the hook, this effectually prevents the jib from getting adrift. Next run up the topmast, fid it, and, within about 3 inches of the top, have a little hook, pass the topsail halyard over this and pin down, pin down the tack, pass the topsail sheet through a little hook in the end of the gaff, thus—haul out and pin into the gaff. The mainsheet is attached to the ring on the main traverse, rove through the ring on the boom, and pinned to the boom. The foresheet is fitted in a similar manner. It is best to



have a series of holes bored along the booms, so that any alteration of the sheet is easily and quickly effected. The jibsheet is sometimes attached to the forestay or bowsprit, rove through the ring on the jib-boom and pinned. I have found the following plan answer better: A piece of whipcord doubled over the forestay, the two ends fastened on each side of the bow, and a wire ring travelling on this span with the sheet attached to it. The pull of the sheet is by this means thrown farther aft. Be careful to see that all the sails set nice and flat, without any creases or wrinkles. Besides the sails already enumerated, a jib headed topsail, that is a topsail without any yard, must be fitted; also three spare jibs, No. 2 one size less than No. 1, No. 3 a size less than 2, and No. 4 a size less than 3. These jibs are for blowing weather when it is necessary to reef your miniature yacht. The Model Yachtsman must be prepared for bad weather occasionally. A model that will not turn to windward against a strong breeze is not much use for match sailing. In our next chapter I shall give a few hints respecting the rig of Schooners, Luggers, Yawls, &c.

CHAPTER VII.

YAWLS, SCHOONERS AND LUGGERS.

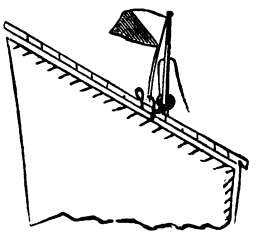
The Latteen Rig and Sliding Gunter.

In determining the rig of a Model Yacht it should always be borne in mind that the fastest rig of all is the Cutter, next to it the Yawl. Schooners are best for sailing with a side wind, or reaching as it is called. The lug rig is easy to fit, and, when the masts are properly placed, even excels the Schooner for reaching purposes; but Luggers, owing to a portion of the sail being to windward of the mast, will not lay so close to the wind as Schooners. Some Model Yacht Clubs have special classes in which the rule is that boats competing therein must have more than one mast. This is done in order to give the owners of Schooners, Yawls, and Luggers a chance of winning prizes, which they would be scarcely likely to do except over a reaching course, if compelled to sail against Cutters. It is advisable therefore for the Model Yachtsman to know how to rig a Yawl or Schooner, and therefore a few hints on the subject will not be out of place. The only difference between a Yawl and a Cutter is that in the former the mainboom is made short enough to allow it to clear a small mast stepped in the counter, that part of the stern projecting beyond the rudder of the vessel. This

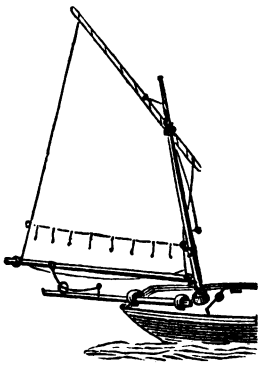
carries a small lug or spritsail called the mizensail. Some vessels have a gaff sail set on the mizen-mast, but they generally have it stepped much further in board, and the mainboom is correspondingly shortened. Vessels rigged in this manner are styled ketches. The ketch rig is a favourite among coasters and fishermen, but yachts are seldom rigged in this way. Should the amateur Model Yachtsman determine on the Yawl rig, he must cut out a mainsail with the same length of gaff as for a Cutter, but the foot ought not to extend beyond the stern-post. The mizen-mast should be a light tapering spar, and should the stern be too shallow to give sufficient support to the mast, bitts must be fixed for it as in the annexed sketch.—

It is a clumsy addition to the deck fittings at best, and it is far preferable to make the stern of the model sufficiently deep to give plenty of housing to the mizen-mast. A thin shallow counter is besides so much waste wood, in reality a counter should form part of the delivery or run of the vessel. I shall have a few remarks to make on the subject of counters in a future chapter.

Having stepped the mizen-mast, which should be in length about one and a half times the beam of the boat, proceed to cut out the sail. A reference to plate 2 will give the beginner a pretty fair idea of the shape of his mizen. The yard to the sail must be fitted in the same manner as the topsail yard in a Cutter, in fact, this is the easiest and simplest way of fitting all lug sails. This sketch explains itself. The loop on the yard may be either wire or cord. Cord is preferable on account of its having more play. The tack of the sail can be fitted with a small hook working in an eye on the mast near the deck thus. —

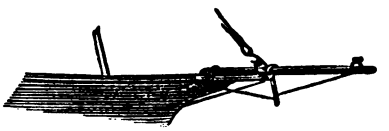


The boom should be fitted in the same way as the foresail already described, and as the sheet would have no power from being so far in on the boom if made fast to the stern, a bumkin is necessary. Two screw eyes sufficiently large to take the spar should be fitted as in the above sketch, and the sheet passed through a ring on the bumkin and pinned to it. Don't forget the cork combings round the mast-hole, and the main traverse should be placed just before the mizen-mast.

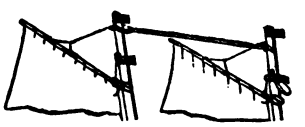


With respect to a Schooner the mainsail and foresail are cut narrower than for a Yawl or Cutter. The forestaysail is fitted in precisely the same way as is the foresail of a Cutter, unless it is intended the craft shall have a standing bowsprit, in which case the forestay must be fixed to the end of the bowsprit. Schooners with standing

bowsprits are not often seen now a days, at least not among racing yachts, and I have found out by experiment that a running bowsprit is the best for working to windward with, in models, the large forestaysail not acting so well as a smaller sail with a jib outside of it. This is a standing bowsprit with flying jibboom attached.—It is not difficult to fit, should the Model Yachtsman desire to have one for his craft and will be found fully described in chapter XI. The



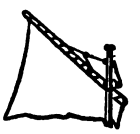
mainsail and foresail of the Schooner are fitted the same as the mainsail of a Cutter, working up and down the masts on rings. A boom must be attached to the foresail working in a goose neck on the mast, as described in chapter V. The two masts must be bound together by means of a stay called the triatic stay. The head of the foresail should be cut sufficiently low to clear this as in the drawing.—This stay must not be too taut. While dealing with Schooners I should like to



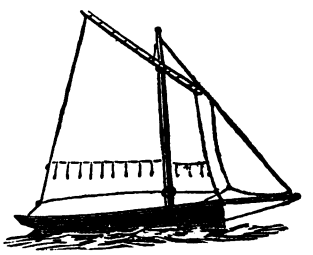
offer a few remarks with respect to the much vaunted superiority of the American style of rigging this class of vessel. Ever since the famous *America*, in 1851, came across the Atlantic and defeated the *Titania*, picked out, though for what reason I know not, as a representative English Schooner, the outside public, at least those who take an interest in aquatics, have fondly imagined that American Schooners are far superior to those built in this country. The failure of the *Cambria* and the *Livonia* to bring back the *America's* Cup has in a measure confirmed this idea. The Americans themselves, however, frankly acknowledge that for ordinary sea going purposes the British Schooner Yacht is far preferable to her Transatlantic sister. This has been proved on more than one occasion. In the ocean race, in 1866, between the *Vesta*, *Fleetwing*, and *Henrietta*, the *Fleetwing* had six men washed out of her cockpit. In the race across the Atlantic between *Cambria* and *Dauntless*, the latter lost two men overboard. Again, in the match between *Cambria* and *Sappho* round Sandy Hook Lightship, in a single reefed breeze, the latter had her decks swept and her gig, which was stowed in the cockpit, *not on deck*, washed overboard. Besides, it must not be forgotten that on two occasions the American Yachtsmen declined to sail against *Cambria* because the weather was "too boisterous," although it was only a double reefed breeze for the *Cambria*. The fact is that experience has taught us that in anything but balloon topsail breezes, raking masts, enormous booms, and gigantic staysails are decidedly detrimental to speed, and what is of equal consequence, handiness. Almost every Schooner of any note in this country, rigged after the fashion of the *America*, has been improved by having her masts placed more upright, and her standing bowsprit exchanged for a running one. Even the Americans themselves tacitly

acknowledge this, for the *Sappho* and *Dauntless* have both had their masts placed more upright and the forestay brought into the stem-head, although they have adhered to the standing bowsprit; and, indeed, it is not to be wondered at that the owners of those vessels are reluctant to do away with the standing bowsprits, seeing that in most American Schooners the bowsprit is regularly built into the bow, and forms part and parcel of the stem of the Yacht. In Schooners with their bearings very far aft, a slight rake is advisable, but the best form for a Schooner, whether a model or a real vessel, is to make her as nearly as possible upon equal displacements. The masts can then be placed upright with advantage, and the centre of effort of the sails, and the centre of lateral resistance thrown more forward than is possible with vessels designed and rigged upon the American plan. As far back as 1858 I found out, by experiment with models, that great rake and large forestaysails were a mistake. But whenever I tried to draw attention to the results of my experiments, was met by the argument "that models were no criterion for real vessels." How many raking masts and standing bowsprits do we see among racing Yachts of the present day? Again, it was held that a real vessel could not possibly sail in anything of a sea with her ballast in the shape of a lead keel like a model. What do we find now, why that leaden keels are the rule and not the exception among racing Yachts. Another important point which I have found out, also by experiment, is that a Schooner rigged vessel requires more beam than a Cutter. In fact a model three times her beam in length will sail faster through the water if rigged as a Schooner than as a Cutter, although she will not lie so close to the wind. This is a peculiarity which I shall endeavour to explain further on. Our principal business at present is to describe the different rigs.

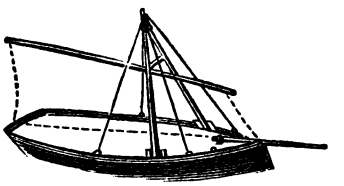
With respect to the Lug rig, various improvements have been made in it within the past few years. The Serpentine Model Yacht Club have some very fast Luggers, indeed, at a distance, they may be taken for Schooners. There is very little of the yard before the mast, and they make the sails stand by means of a peak halyard, so—



The real old fashioned Lugger, however, had her yards slung about one-third from the fore end, and the tack of the fore lug reaching to the stem-head. Such vessels are powerful reaching boats, but will not lie so close to the wind as a Cutter, Schooner, or Yawl. Some attempts have been made to introduce the lateen rig among yachts. The Norfolk and Suffolk Yacht Club have several craft rigged in this style. They are not much account when it blows a fresh wind; owing to the immense yard they carry they are not easy to handle in a breeze. The only way to make a lateen sail effective in a



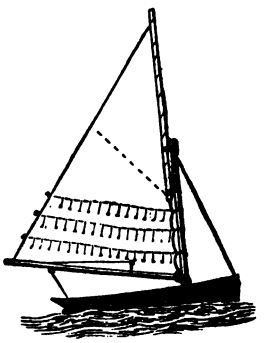
model is by having it set between sheers instead of on a mast. The sheers are easily fitted, being merely two spars, rather lighter than a mast would be, set into chocks on each side of the deck, opposite the mast-hole. They are joined at the top by a cap, and hauled taut into their place by the forestay. A small batten across the top will take the halyards of the lateen yard, and a topmast may also be fitted. The sketch will show how this is done. The dotted line merely shows the position of the sail when set. It is an unhandy rig, however, and not to be compared to the Cutter, Yawl, or Schooner.



With respect to spritsails, they can be made to stand very flat, but are troublesome to reef, and the weight of the sprit is more than double that of a gaff. However, here is a sketch showing how to fit a sprit, the upper end goes into a loop, either of wire or cord, in the peak of the sail, and the lower end into another loop on the mast at a little distance above the main boom. A short bit of cord fastened to the middle part of the sprit keeps it from swaying about too much. I would advise the Amateur Model Yachtsman to stick to the gaff sail and eschew lugs, sprits, and lateens Some years ago a gentleman named Shuldham invented a revolving double mast or sheers for the lateen rig, it did not answer very well, except in fine weather, and was found inferior to the Cutter for all practical purposes. The fact is there is no rig equal to the Cutter, and the American Sloop is not a patch upon it. The sketch will explain the difference between the American Sloop and the English Cutter. In 1867, in the United States, I tried a series of experiments, in conjunction with some American Model Yachtsmen, with regard to rigs, and the conclusion I arrived at was this, that the Cutter rig was superior to the Sloop in every point of sailing. The long boom makes a model very unsteady. The sails are bent the same way as for a Cutter, except that the booms are laced to the foot of the sails, and the gaff topsail is set with a small jackyard (see the sketch). This is also laced to the foot of the sail.

Last, but not by any means least, is the Sliding Gunter Rig. This is in fact a Cutter with mainsail and topsail all in one. There is an

important difference, however, inasmuch as the topmast in a sliding gunter works abaft the mast instead of before it. The caps are fixed on the topmast instead of on the lower mast, and the topmast lowers down with the reefs. It is a simple sail to fit, only requiring to be laced to the topmast and a few rings on the lower part of the sail. A halyard fast to the heel of the topmast, passing up through the caps thence through the lower mast-head, with a pin on the end of it to pin it down to the mast; a pin stuck in above the lower ring will keep the tack down, and the outer clew is hauled out, and made fast to a cleet on the boom (as described in chapter VI.). This is a very effective sail for going to windward with in a strong breeze. When the sail is reefed it has very little weight aloft, and yet, being lofty, steadies a boat through heavy seas. When the sail is set up to its full extent it does not stand well without a little sprit in it, where the dotted line is in the sketch; this after all makes it partake of the character of a gaff sail with a jib-headed topsail set over it. The great objection to the sliding gunter is that boats rigged in this fashion do not run well before the wind—at least they are at a disadvantage when sailing against a Cutter, especially in winds when a square headed gaff topsail can be carried. The narrow head of the sliding gunter sail does not seem to have the same power of pushing the boat through the water as the squarer mainsail of a Cutter.



CHAPTER VIII.

SAILING.

Discovery of Sail as a Motive Power—Steering a Model—The Weighted Rudder—Balloon Sails, &c.

Having now got his little craft all-a-taunto, the would-be Model Yachtsman may fancy that nothing more remains to be done, but enter her in a match, and walk off with the prize. Should he do so without a preliminary trial, our friend must not be very much astonished if she is, to use a familiar but slangy phrase, "licked into fits." The fact is, a Model Yacht requires even more delicate handling than her larger

sister, and it requires no small amount of patience and perseverance to learn how to sail a model properly. There are professional hands among Model Yachtsmen who will sail your boat for you for a consideration, but it is much more to the credit of the Model Yachtsman if he sails his craft himself. It is an old adage, that "practice makes perfect," and a few hours spent in the early part of the day round a nice sheet of water will do wonders towards making any one who takes a real interest in miniature yachting a good model sailer.

First and foremost, the beginner must learn how to steer his little yacht. "Oh, that's simple enough" the reader may exclaim, "You have only to put the rudder at a certain angle, and the boat must turn in that direction." Just so, but that is exactly what the Model Yachtsman does not want. What is required is that the craft shall keep going steadily on any given course without turning in any direction.

Before the invention or rather adaptation of the weighted rudder, it was a hard matter to make a model vessel run dead before the wind. A model may be made to sail with a side wind, or even go close hauled, by the simple process of balancing the sails. And here let me digress a little, in order to explain to the uninitiated the meaning of the terms, close hauled, reaching, running, &c. A boat is said to be close hauled when she is sailing as close to the wind as she can lie; reaching is sailing with a side wind, or wind on the beam; and running is sailing with the wind right aft. It is, of course, known to every schoolboy, that the wind exerts a certain pressure or force upon the surface of anything opposed to it. This pressure, of course, varies with the strength of the wind, from the faint zephyr scarcely sufficient to fan the cheek on a hot day, to the resistless hurricane uprooting trees and hurling down buildings.

Now water, like all fluids, is elastic, and readily admits the passage of anything that is driven through it with sufficient force; it, therefore, naturally follows that anything floating on the surface of the water must yield to the pressure of the wind in a greater or less degree, and so long as the wind keeps blowing in one direction, so the object in the water will be driven the same way. No doubt the first attempt at a sail made by the first navigator, in "the days when Earth was young," was by holding up a piece of bark, or possibly a few leaves tied together, and thus helping the log on which he was sitting, faster along the current. The reader may not, perhaps, have heard the romantic story attached to the discovery of sailing? It is related by an ancient writer, that on the shores of Phœnicea, somewhere about the days of Abraham, dwelt a very beautiful maiden, the daughter of a fisherman, who, in his rude canoe made out of skins, rushes, or possibly the single trunk of a tree, hollowed out either by art or nature, supported his family by capturing those denizens of the deep which frequented the neighbourhood of his residence. The young damsel, like her modern sister whose personal charms are somewhat

above the average, had a score or two of lovers, but there was only one whose suit was favourably received by the old fisherman, and happily his daughter also preferred her father's choice to the rest of her adorers. Handsome young ladies, in those days, were it appears rather scarce in the locality mentioned, for notwithstanding all the rebuffs which the unsuccessful suitors received, they seemed determined not to yield up possession without a struggle, for their whole energies were bent upon preventing the happy man from having even so much as five minutes *tète-a-tète* with his betrothed. The young lovers were, however, not to be beaten, so one fine afternoon they embarked in one of the old fisherman's canoes for a little uninterrupted spoonying. The sea was smooth, the breeze light, and the sky unclouded. Absorbed in their admiration for each others society they soon forgot all about the shore. The oars hung listlessly in the hands of the youth while he poured his love speeches into the ears of his beautiful companion; meanwhile the shades of evening were stealing on apace, and bringing with them the sea breeze rather fresher than usual, and every appearance of a dirty night; and it happened that just as our young Adonis was pressing his blushing inamorata to name the happy day, a furious squall struck their frail craft, nearly capsizing it. In his fright the lover allowed both oars to slip from his grasp, and, after a few desperate efforts to recover them, they were abandoned, not before the gallant had volunteered to swim for them, a project decidedly negatived by the lady, who declined to be left to the mercy of the winds and waves in an open boat without oars. They both called on Neptune and all the other gods and goddesses of the sea to see them through in safety. It is said by some historians, that the young man gave himself up to despair, and made use of language too shocking to be repeated, but this may have been only a bit of spiteful scandal invented by one of his unsuccessful rivals; be this as it may, the fisherman's daughter showed the more sense of the two, for she suddenly conceived the idea of utilizing her feminine garments as a means of propelling the boat shorewards. Assuming the command, and, by way of a preliminary, sending her lover aft, with strict orders to keep a look-out for Neptune coming up astern, and not to turn his head under pain of being spiflicated, she rapidly divested herself of her drapery, which in those days was specially voluminous, and holding it out at arms length, the boat sped away before the wind like an arrow, and before they were aware of it the stem shot on to the sand, precipitating the luckless individual in the stern sheets on to his back in the bottom of the boat, and before he could recover himself, the boat was high and dry, his mistress flown, and the art of sailing before the wind discovered. Some chroniclers hand us down the report of a speech, made on the occasion of the nuptials of the young couple, by the old fisherman, in which such expressions—"The future is unfolded to my view." "My child, you have just discovered a powerful agent in Navigation." "All nations will cover the oceans with their fleets." "The divine fire

in the human breast, ... triumph of art over nature"—and other such high falutin sentences occur, showing that post prandial orations were much the same in those days as they are now.

At what period of the world's history the art of beating against the wind became known is uncertain. That the ancient Greeks and Romans were acquainted with it, is evident from the writings of those poets and philosophers who have favoured us with descriptions of the life and times in which they lived. Virgil, for instance, in the Œneid, makes Palinurus, the skipper of the Trojan hero's ship, order his crew to "Contract their swelling sails and luff to wind," but the breeze proved too strong for them, for after a vain attempt to get to windward, the skipper admits his inability to make head-way, in the lines—

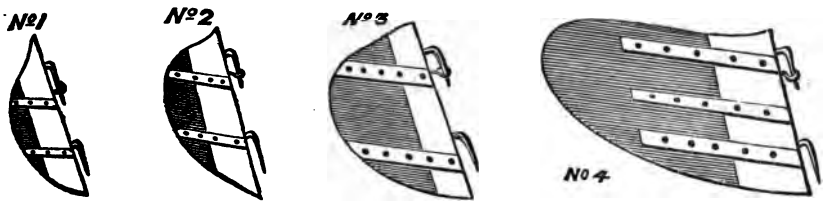
"——— Too sure I find
We strive in vain against
The seas and wind."

There is this to be said, that even presuming that the science of beating to windward was known to the early navigators, they never made much use of it, for they seldom put to sea without a fair wind, and when caught out in a contrary breeze, generally bore up for a port.

For the benefit of those not well up in nautical lingo, it will be as well to explain, that when a vessel has her sails trimmed and arranged to sail against the wind, she is said to be "Close hauled." I have used the term, against the wind, but it is obvious that nothing short of a steamer can steer direct against the wind; a sailing vessel has to make a series of zigzag movements, called "Tacking." As the side of a vessel presents more resistance to the water than the bow, it is, of course, much harder to drive a vessel in that direction than to force her ahead. Now, if the sails of a vessel are trimmed at an angle across the deck, say 45 degrees, the wind strikes against them obliquely, and glancing off, has a tendency to drive the vessel ahead. Inasmuch, however, as part of the power exerted by the wind striking the sails at such an acute angle is expended in pushing the vessel sideways, her course will not lay exactly in the direction to which the bow points, but a little on one side of it, to leeward of it, in fact, this is called, "Leeway," and the more leeway a vessel makes, the longer she will be in getting to the point from which the wind blows. An ordinary, and indeed any vessel will sail fastest with the wind two to three points abaft the beam, because then the breeze is exerting its maximum force upon every sail; but a properly constructed Cutter ought to sail almost as fast through the water, close hauled, as she will in any other direction. In fact, to make his model go well to windward should be the aim of the Model Yachtsmen. Anything will reach and run provided it has canvas enough, but it requires no small amount of skill in designing and handling to beat against the wind; hear what Vanderdecken, writing in *Hunts' Yachting Magazine* for 1854 says—"However familiar to us the art of making a vessel sail to windward in the very face, as it were, of the breeze which

propels her may be, it seems, on consideration, one of the most curious inventions which human ingenuity has yet discovered. It is more surprising even than steam itself, for there you have another force generated and applied no doubt with wonderful art, to the propulsion of the ship, but in the case of the sailing vessel, you have the very force which appeared to be battling and striving to keep her back, in reality, urging her forward." While, however, making the weatherly qualities of his boat his principal study, the Model Yachtsman must pay some attention to other points of sailing, because regattas are sailed over fixed courses so as to bring all points of sailing into play.

The first consideration is the steering of the model. This, thanks to the weighted rudder, is easy enough. A fixed rudder with helm fastened at certain angles cannot answer, from the simple reason that a vessel requires different degrees of helm at different degrees of inclination. A properly constructed vessel, when pressed down on her side, has a strong tendency to shoot up into the wind; but as the wind lessens this decreases, and, therefore, the degree of helm necessary to keep her straight in the height of a squall, will turn her head right away from her course after it is over; therefore, as in a model it is impossible to have somebody at the tiller to ease the helm, an apparatus is necessary by which the helm can be altered at various degrees of inclination. The weighted or balanced rudder, as adopted, in 1855, by my brother R. J. Biddle, the Marine Artist, I have found the most effectual. A model generally requires from four to six rudders—No. 1 for beating to windward, No. 2 for reaching, No. 3 for a quartering wind, and No. 4 for running dead before it. Where great nicety is required in the trim, a couple of intermediate rudders may be made; but all this can only be found out by experiment and practice. The beginner at Model Yacht Sailing had better content himself with the four ordinary rudders, such as are given in the cut below.



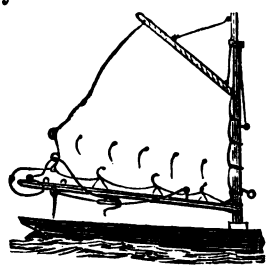
The best way of making these is to cut them out of a piece of thin, hard wood, and fasten the lead, which must be stout sheet lead, on with strips of brass, copper, or zinc, nailed on to both wood and lead with small copper tacks. The pintles are stout brass pins hammered flat at the part which enters the rudder, in order to prevent its turning round and splitting the wood. Another pin bent into the form of a hook, acts as a clasp, so that after it is shipped in the gudgeons or eyes in the stern post, the rudder cannot come off easily. The principle is the same as the safety pins used in dressing children. There are

other plans of steering models in use. Some have a tiller fixed to an ordinary rudder, only sticking out abaft instead of forward, with a leaden bullet on it which screws in and out, as occasion requires. This is a very good way of steering, but not so reliable as the series of rudders, at least I have not found it act so well. I have seen a plan of fixing the tiller to the mainsheet, and thus the pressure of the mainsail acted upon the helm; but it never answered, so the Model Yachtsman had better not try it, but stick to the directions given, and make a series of rudders as already explained. The weight of No. 1 for a 2 foot model should not exceed 1 oz., No. 2, 2 ozs., No. 3, 3 ozs., and No. 4 about 5 ozs. Of course these weights vary in different models. The best way is to make the rudders in the rough at first, and trim them down with a knife to what the boat likes best, which can only be found out by actual experiment under sail.

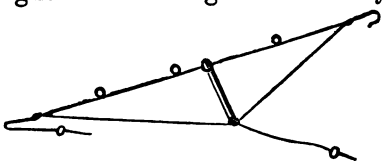
We will suppose that the rudders are made, boat nicely packed up, and everything ready for a start to the locality where the Model Yacht Regatta is to take place. Take a careful look round to see that no spars or sails have been left out of your parcel; and then put into your pocket, a pair of pliers, a fine needle bradawl, some binding wire, wound round a cotton reel to make it carry better, some rigging cord, and a paper of pins. This may seem rather a large assortment, but the whole lot won't take up much room in the pocket, and will be found very useful, indeed it is never safe to leave any of the items mentioned behind when going Model Yachting. Arrived at the banks of the water, glance at the direction of the wind, and notice whether it is steady or squally; if the latter, and it is not too strong for a topsail, set the jib-header, because that will not lay the boat over so much in the puffs as the yard topsail. With jib-headed topsail she ought to carry No. 2 jib, unless the wind is abeam, when of course the largest jib can be carried with advantage. Supposing it is a beat to windward, then trim her sheets well in all round, and watch to see how she acts. "Ha! she does not luff up like that other boat which started just to leeward and is now well on my weather." Well, Mr. Tyro, don't be in a hurry, try a little more mainsheet in, or ease the jibsheet a trifle, or perhaps the rudder is a trifle heavy, if so cut off a piece of the lead and try again. When you find that she lays over too much, and sags bodily away to leeward, it is a sign she has too much sail; so down topsail, house topmast, and if she has No. 1 jib exchange it for No. 2, then try her again.

When it comes to running before the wind, let the mainsheet go off until the boom is square with the beam or right across your little craft. Ease up the fore and jibsheets, and if it is a fresh wind, and you are carrying a topsail, ease down the head of it, this enables a model to run steadier, because the topsail has a tendency to bury her bow and make her broach-to, or come sideways to the wind. When your model is under a reefed mainsail, her weatherly qualities may sometimes be improved by setting a jibheaded topsail over the reefed

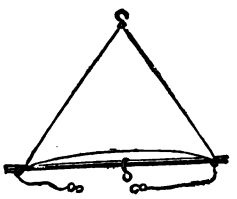
mainsail. In fact, if there is wind enough for a single reefed mainsail take two reefs in, and set a jib-headed topsail over the reefed mainsail. With this sail No. 3 jib ought to be carried. In reefing lead the earing at the lower clew of the mainsail through an eye on the boom corresponding with the wire loop in the edge of the sail, and belay it to the cleet on the boom thus—



A storm foresail about two-thirds the size of the ordinary one is also a useful sail, as in very blowing weather it relieves a boat immensely, and enables you to carry a larger jib than you would with the big foresail set. With respect to balloon sails they are only useful in very light weather. A jib-topsail is a handy sail for reaching in gentle breezes, it is set by hooking the lower end to the bowsprit, and the upper end to the topmast head, the sheet can then be brought down through the forestay collar to the mast and pinned in. A sprit across it, as in the drawing, enables it to stand when close hauled if required.



A topmast stay makes the gaff-topsail set better, and therefore, I should advise the Model Yachtsman to fit one. It leads from the bowsprit end to the topmast head, and the jib-topsail can be made to run on it by simply having a few wire loops, as shown in the drawing. The angles at which a model likes best to carry her sheets can only be learnt by experience. A few trials against another boat will soon show you how your little craft likes to be trimmed, and then with a pencil mark the places where she likes the sheets. Your bradawl will be found useful for boring fresh holes for the sheet pins, and the binding wire and pins will be handy for repairing damages, should you carry away any of your spars or gear. A nice neat oilskin case with a flat piece of wood as long as your longest topsail yard tacked on the inside, is almost indispensible for carrying spare sails, such as balloon topsails, &c., the long slender yards easily breaking in the hand, whereas if wrapped up in the case they are safe, besides keeping clean and dry. Model Yachts sometimes carry spinnakers before the wind, but they are of little benefit unless the wind is right aft. The best way is to make them triangular, thus—



with a boom at the lower part; this is hooked on to an eye in the fore-side of the mast, and the upper end to an eye just under the collar of the forestay. Then, no matter which gybe your craft is on, *id est*, which side she carries her mainboom, there is some of the spinnaker drawing. A square sail may be set in the same way. For reaching in very light winds, one large sail reaching from

the topmast head to the bowsprit end and into the mast, called a spinnaker jib is very effective, but only when the wind is very light. Directly there is the least breeze in it must come, and the usual jib and foresail set, as then it only buries a boat's bow in the water, and drags her away to leeward.

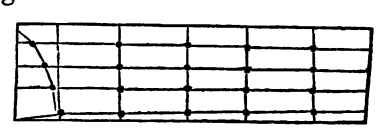
Above all things the would be Model Yacht Sailer must learn to balance his sails properly, so that the boat, when close hauled or reaching, will almost steer without any rudder at all. Too much attention cannot be paid to this, as the proper disposition and set of the sails has a great deal to do with the success of your little craft.

CHAPTER IX.

THE BLOCK MODEL.

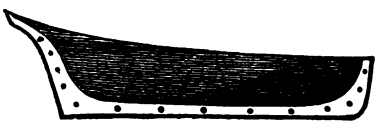
BUILDING—PAPER BOATS—TIN AND ZINC MODELS.

THERE are various ways of constructing a model besides that already described. Many of these are simple enough, while others are troublesome in the extreme; and the time and labour wasted in getting the craft true to the design, would suffice to make three or four miniature yachts in the bread and butter fashion. Still, sometimes it happens that one has a nice piece of wood handy which is just the right dimensions, and, therefore, no harm can be done in giving a few hints which will be of service to the amateur. In making a Block Model care must be taken to have the wood perfectly square, so that a line drawn down its centre may be true with both ends. Take your compasses, rule, and pencil, and mark out the deck lines from your drawing. Then, with your straight-edge and T square, rule off a series of lines down each side, corresponding with the horizontal lines of your design. Now divide the block into squares, similar to the cross lines of the diagram Plate 1. Do this on both sides, of course marking where the keel, stem, and sternpost go.

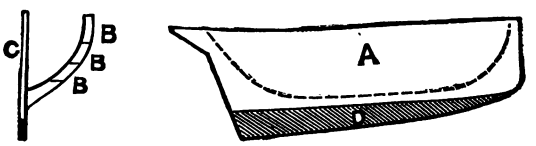


Now measure off from the design the exact distance line. No. 2 from the top, is from the outer edge of the wood, and mark this on a long bradawl with a file. Place the bradawl so that it cuts line No. 2, and bore in till the mark is reached; do this all round, and upon every line, until both sides are complete. The cut shows the series of holes which will then appear upon the sides of the block. Now off coat, and fixing your block in the chocks on the bench, cut away until you come to the

bottom of each puncture in the sides of the wood. You must treat your block of wood in precisely the same manner as the sculptor does his block of marble. It is rather hard work cutting a boat out of a single block; but a little attention given to the measurements and borings, will enable you to turn out a model tolerably correct to a previously drawn design. When the outside is finished, and before the final polish with glass paper, she must be scooped or dug out. Mark a line round the deck about one-eighth of an inch from the edge, and with your small chisel cut a groove. Place the craft between your knees, if small enough, or in the chocks, and scoop the inside carefully out with your gouges. Using the 1 inch gouge to begin with, and the smaller one as occasion requires, keep feeling the sides with your fingers as you get down into the boat, so that she is evenly scooped. Let her, when finished, be about $\frac{1}{8}$ of an inch thick all over, if a 2 feet model; $\frac{1}{4}$ of an inch for a 2 feet 6 inch, or 3 feet model, and so on in proportion. If you are using mahogany for your model, she may be scooped a little thinner. It must not be overlooked that in cutting out a model from a solid block, the eye has a great deal to do with shaping the lines, and in getting both sides alike. Care must be taken that there are no ugly lumps or angles, because nothing stops a boat more than inequalities of surface. The trueness of the model can be best confirmed by cutting a series of sections out of zinc or cardboard. The spokeshave will be found a most useful tool in shaping the sides, and a large gouge, with very little concavity in it, must be used for making the curves and hollows of both bow and run. When the inside is finished, which should be smoothed down as much as possible, so that she is of an even thickness all round (care being taken that the bottom where the keel goes is at least half an inch thick to hold the screws), you may then paint her inside, and go over her with No. 1 and No. 2 glass paper. The roughnesses left in working the wood rasp may be scraped off with pieces of glass. Go over her until the outside is as smooth as a polished mahogany table. You may now paint her outside with either red or white lead, and then proceed to cast your keel, fit it, give her another coat of paint inside, and then put on the deck, and finish her off as described in chapter IV. There is another way of making a block model, and that is by having the two sides separate, and, when complete, carefully weighing them to see they are exactly the same weight, and joining them longitudinally with rock marine glue, and screwing them together with brass or copper screws. Each side will present this appearance before they are joined. The dots represent the places where the screws go. The heads of the screws must be counter sunk and filled in with gold size putty on the outside. Great lightness can be obtained by this method, because in scooping,



by having the boat divided longitudinally in half, you can work your gouge down into the dead wood fore and aft lower than if she was joined together in those parts. Another mode of constructing is to take a plain board ½, ¾ or 1 inch thick, according to the size of your model, and cut it to the exterior shape of the boat, and proceed to

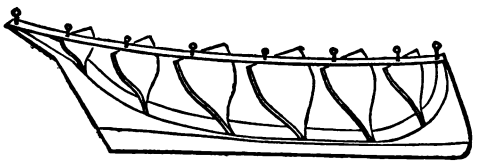


build on each side bread and butter fashion. A good plan, if constructing in this manner, is to cast the keel first, right on to the board. This is easily done by tacking a strip of ¼ inch stuff on both sides to the depth you intend your keel to be, placing a series of screws along the bottom of the board and stopping the ends, as described in making a mould in chapter IV. By taking off these battens after the casting is cold, you have your boat's keel already on, and it can be trimmed down afterwards to the weight wanted. A is the board, D the lead keel, BBB the pieces or sides of the model, which must be sawn out and trimmed down to the lines both inside and out, before going on to the board. C is an end on view of the board. The dotted line shows where the board must be cut out, when the sides are complete. Screws should be placed in the ends of each piece, where the dots are in A, and the pieces joined with marine glue, either Rock, Collins, or Prout's. In all these plans it is best to put the deck over all. Some model makers leave a ledge for the deck in scooping, and let it in, but this makes the top sides thick and heavy. A better way is to scoop the top sides as thin as possible, and then, if it is desirable to let the deck in, screw a nice neat batten ¼-inch square, or more, according to the size of your craft, all round inside for the deck to rest on, of course placing it low enough to give a little bulwark if desired.

No work on Model Yacht Building would be complete without a short description of how to construct a craft with ribs and frames. I would advise the Model Yachtsman, however, not to attempt building a model by this method under 3 feet long. When the size is less than 3 feet, the work of planking becomes tedious and troublesome. The planks are obliged to be so thin that great care is necessary to prevent splitting when boring the holes for the fastenings. There are three ways of building, namely, the clincher, carvel, and diagonal. In the first named a few moulds only are necessary, the planks overlaping each other like the slates on the roof of a house. The carvel build must have in addition to moulds a series of ribs, more or less close together, according to the size of your craft, and the planks fit one on top of the other, the seams being payed or caulked when finished either with putty, white lead, marine glue or pitch. In the diagonal

the planks are placed slanting, from the top rim to the keel, and ribs are dispensed with altogether, the requisite strength being obtained by placing another series of planks slanting the opposite way, inside the others. In all these builds the leaden keel must be affixed first to the kelson, when I say must, I mean that it is the best way to proceed. Begin by having a board cut the shape of your boat, as figure A in the preceding cut. Cast your keel, and then cut down to the dotted line. Now fix your board keel downwards into the chocks on the bench, wedging it in firmly. Take the design for your model, and cut out of thin $\frac{1}{4}$ or $\frac{1}{8}$ inch picture frame backing the mould sections exactly corresponding with the mould sections of your design, measuring them off as explained in Chapter 2. Now along the bottom of your board cut a series of slots for the moulds to fit in.

This is the board with the sections set up. They must be fixed in their places with marine glue. Be particular to observe that all the mould sections are perfectly true with each other. Now take a piece of $\frac{1}{4}$ inch board, slice off a thin strip the length of your craft, and

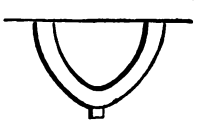


place it along the middle of your mould sections, nailing it down to each, and also to each end of the board, in an exact line with the keel. Now take a piece of $\frac{1}{8}$ inch Cedar or Pine board, see that it is free from knots, smoothly planed, and cut it into strips $\frac{1}{2}$ inch wide. Get a piece of thick drawing paper, and cut it also into strips $\frac{1}{2}$ inch wide. Both the strips of drawing paper and the board must be a few inches longer than the vessel, because the bending and twisting into the shape will shorten them considerably. Begin at the keel, and bend a strip of drawing paper into the shape of the boat, at that part fixing it into the place with a pin stuck into each mould. A good plan is to cut a bevelled groove along the board, just along the top of the lead keel. This is called the rabbet of the keel, and can be easily cut with a small rabbet plane. The lowest plank of all then fits into this groove, and can be fastened to the lower part of the board, which we will call the kelson, and saves the trouble of putting in strengthening pieces called stringers along the inside of the lowest plank. To resume, you will find that the paper plank must have a little of it trimmed off on one side in places, to make it fit properly. Mark this with a pencil, then take it off, trim it into shape with a pair of scissors, lay it along one of the wooden strips, mark it off, trim down the wooden strip or plank as we will call it to the same shape, and fasten it into its place along the keel with fine copper flat-headed nails $\frac{1}{2}$ inch long. Bore into the wood first with a fine bradawl to obviate fear of splitting. Do the same with each plank, working up the sides alternately. Keep the planks close together. White lead mixed with gold size, until it is like stiff paste, laid along the top of each plank and into the groove of the kelson before

the lowest plank goes on, will help to make her tight. The groove along the kelson must be continued right up into the dead wood fore and aft, so that the planks when put on come flush, and do not project. This saves a lot of trimming down and puttying after the boat is complete. The top plank may be double the thickness of the others, but by bevelling in the top of the mould sections a little, and making the plank slightly thicker than the others at its top, tapering to its lower edge, enough thickness may be had for securing the deck top without the extra weight of doubling.

This is the way to build a carvel boat. In the clinch build the planks require to be slightly broader, and must overlap at least $\frac{1}{8}$ of an inch, and then they are fastened in the same way. The moulds already placed in, will be sufficient for a clinch built craft, but for the carvel build, ribs must be added. The shape of these can be ascertained by taking a strip of sheet lead and bending it into the side (inside the boat) in the place the rib is to go. There ought to be in a 3 feet model, one rib between each mould section. Take this piece of lead, and placing it on a piece of $\frac{1}{4}$ inch board, mark off with pencil its shape and cut it out of wood. Place the rib in its position, and fasten to each plank with copper nails as before. In building, two hammers are used, one in each hand, one inside, the other outside, this is to prevent any springing in the planks, which would occur if struck in the ordinary manner. Besides, this clenches the nails when they come through on either side. The ribs may be cut with a slot to fix over the kelson, this adds to their strength.

It will be observed that the mould sections are solid, therefore, now the planking is finished, this extra weight may be taken away, by cutting out the inside of these mould sections, thus:



A fine keyhole saw will soon do this, and now your craft is already for caulking, painting and decking.

The inside should be well coated with paint, after the seams inside and outside are thoroughly filled in with white lead mixed with gold size. One word as to the stern, or rather counter of a built model. This is troublesome to make at first sight, but by steaming the planks well, over a kettle of boiling water, you will find they bend into the shape required very easily. The board acts as a guide, and a little mould section of the counter may be tacked on each side as a help in fashioning the stern. The deck will be placed on in the ordinary way, three or four beams being put across just to bind the craft together. A diagonally built model is very troublesome to make, it is so hard to get it true, and therefore is best let alone by the Amateur Model Yachtsman.

A very ingenious way of making a light model was shown me by a gentleman some time since. I call it the *Papier Maché* boat. First make an ordinary block model, and then lay over it a sheet of brown paper, wet, so that it takes the shape. Then with a pot of stiff paste

go over the whole and add another sheet, and so on, until you have enough sheets (eight or ten) to make a stiff surface, which retains the shape. The difficulty is to get the block model out of its paper mould after it is done, but if the block model is made broadest on the deck, with raking over sides, the paper coat comes off easily enough. Half a dozen coats of varnish inside and out, with a wooden kelson nailed inside to screw the lead keel to, with a batten round the rim for the deck to fasten on, will complete your paper boat. They will stand a considerable amount of knocking about, being as tough as leather, but owing to the difficulty of getting them off the mould, as before stated, they are obliged to be of one peculiar shape. Besides, there is, of course, the additional trouble of making a block model first, unless you have one lent you to use as a mould.

Some Model Yachtsmen have tried tin and zinc as a material with which to build, but models made of these metals are not favourites. They are troublesome to make, and are liable to be bent out of shape by a very slight cause. However, in case a reader of this little book should desire to construct a tin or zinc model, I will explain to him the "easiest way to do that same," as Paddy says. First provide yourself with a stick of solder, a blow pipe, some resin, or spirits of salts, not forgetting a soldering iron. Cast your leaden keel, and to each side, about half way down, nail a strip of tin or zinc, as the case may be, with *brass* nails. Then fix another strip of somewhat stouter tin or zinc for the stem, and another for the stern post, on to the ends of the keel, securing them in their place with the strips already spoken of, which must project above the keel at least an inch. You have now the keel, stem and stern post complete; put a series of wooden mould sections into the trough formed by the two zinc strips and the leaden keel. Secure them in their places, and run a batten along the top, taking the centre of the moulds, and fasten to the top of stem and stern post. Now cut a series of strips of zinc or tin about 1 inch to 1½ inch wide, and nail them on to the wooden moulds, similar to planking, only making the strips overlap, hammering them into the shape required. When both sides are completed, take the blow pipe and your solder, run a little resin into each seam, and then blow a flame sufficient to melt the solder, and carefully solder each seam, not forgetting the ends or butts as they are called. When this is done, the wooden moulds may be withdrawn, but it is better if they are left in as strengtheners. A ledge of wood may be nailed on inside the top strip of zinc to take the deck. Beams must be put across, and if the seams are soldered fore and aft, inside as well as outside, all the better. Three or four good coats of paint must be put inside before decking. A chock of wood must be placed in the bottom, into which the mast will be stepped. The eyes for the rudder pintles to work in, must be made of the same metal as the boat, and soldered on to the stern post, as also the bobstay shackle.

I think I have now explained the principal modes of constructing

Model Yachts. There are several other ways of building real vessels, notably the Canadian plan of dispensing with ribs altogether in a carvel built boat; moulds are put in temporarily, and the planks are nailed one on to the other downwards, with long French nails. The planks are cut square, from 1 inch to 3 inches, according to the size of the vessel, and the seams payed with white lead. When finished, the moulds are knocked out, and the boat is complete. This plan is, however, unsuited for boats of less than 10 feet or 12 feet long. Speaking from experience, I prefer the bread and butter fashion, as the simplest, easiest, and most satisfactory for all models up to 4 feet in length. Beyond that size it is best to build or make them bread and butter fashion in half sections, with the board between, as explained in the beginning of this chapter.

CHAPTER X.

CENTRE BOARD MODELS.

Advantages and Disadvantages of Sliding Keels. How to Fit a Centre Board.

It may appear strange to many that so few experiments have been tried with centre board models on this side of the Atlantic. The excuse has been the difficulty of steering a model fitted with a centre board. This is, to say the least of it, rather a lame apology upon the part of those Model Yachtsmen who profess to be well up in the sailing and handling of miniature racing craft. The truth is that the failure to turn out a successful centre board model may be traced to the fact that most persons labour under the impression that a centre board can only be carried in a vessel of excessive beam and very small draught. That a sliding keel boat requires more breadth in proportion to her length than a fixed keel boat is true, at the same time there is no occasion to rush into the extremes which most Model Yachtsmen do when they devote their attention to the construction of a centre board Yacht. The reason why most vessels (I am speaking now of real Yachts) are given great beam when intended for a centre board, lies in the fact that such craft are designed for a special purpose, namely, passing over sand-banks, and through channels that are barred to an ordinary vessel. Consequently the draught of water must be as small as possible. Now a sailing vessel, whether a model or otherwise, must have a certain amount of stability, to enable her to stand up under canvas. This

stability may be either natural or artificial. If the latter is required, weight must be placed in the boat, low enough to counteract the pressure of the wind on the sails. If the former, the boat must be constructed so that her natural inclination is to float, in the phraseology of the carrier, "right side up." The subject cannot be better illustrated than by taking an ordinary plank and placing it in water on its edge. The plank will, directly it is left alone, fall on its broad side, and the only way to keep it on its edge is by adding weight, in the shape of lead or iron sufficient to counteract its tendency to fall over.

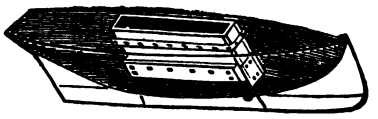
The position assumed by the plank with the weight attached is not its natural one, because, remove the weight, and it immediately floats on its broad plane. If, however, you add three or four other planks to it, that is, place them one on top of the other, so that it approaches more nearly to a square baulk of timber, the tendency to float on its broad part will be much lessened, and with the addition of two or three other planks, so as to make it a perfect square, it will float on any one of its four sides, according as it is placed in the water, although the tendency is to float on the points of the square. When, therefore, a boat-builder starts on the construction of a very light draught vessel, which shall at the same time be a fast sailer, he has two important points to consider. The first is how to make his craft carry sufficient sail to drive her through the water at what we may call a racing speed, secondly how to provide her with sufficient lateral resistance to enable her to beat against the wind. The first difficulty is overcome by giving his craft excessive beam, and the second by placing within the boat a broad flat piece of wood or iron, which can be lowered through the bottom, or hauled up again, as occasion requires. Barges and other shallow draught trading vessels have what are called "lee boards," that is broad flat pieces of wood, fitted one on each side, so that one on the lee is let down when close hauled, and the weather one is then hauled up. They are considered to be an unsightly appendage, and therefore Yachtsmen prefer a board in the middle of the vessel, where it does not detract from the appearance whether it be up or down. The Americans, however, have eschewed lee boards altogether, their shallow draught trading vessels being fitted with centre boards.

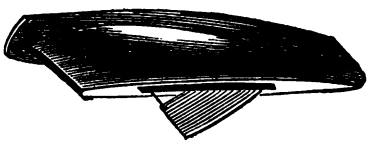
With regard to the respective merits of lee boards and centre boards, opinion is generally in favour of the centre board, though there are a few practical seamen who maintain that two lee boards at the sides are quite as effective as a single one let into the centre of a vessel. So far as models are concerned, I have found by experiment that a boat will go faster to windward with a centre board than she will with lee boards. As I have already mentioned, centre board Model Yachts are generally made with such excessive beam, that it is next to impossible to steer them, and they are condemned in consequence, the blame being laid upon the centre board, whereas the latter has very little if anything to do with the unsteadiness of a model. There is no reason in the world why a centre board Model Yacht should not sail as

steadily as one with a fixed keel. A very good proportion for a centre board model is from four to four and-a-half times the length of the beam. A vessel constructed of these proportions, ought to be at least half the depth of her beam. The floor must be brought up with an easy round, extending at least one-third of the length fore and aft, the bow slightly hollow, especially under water, and the run rather fine if anything. A leaden keel, say about ¾ of an inch for 2 feet, 1 inch for 2 feet 6 inches, and 1¼ inches for a 3 feet model must be added. The centre board drops through the keel, and is hauled up and down as occasion may require. The advantage of a sliding keel is, that in running off the wind you can haul it up, and thus lessen the boat's displacement very considerably. When it comes to a beat to windward, down goes the extra keel, and thus the lateral resistance is augmented correspondingly. Another advantage is that you have a much lighter craft to carry about with you. A 3 feet centre board model ought not to weigh, all complete, more than 9lbs., while an ordinary fixed keel boat of the same size would weigh 14lbs. or 15lbs. at least. Its disadvantages are, that in strong winds and much sea the centre boards cannot compete successfully in beating to windward against the heavier and deeper keeled boat. Then, again, in matches, where the course is an all round one, the time lost in lowering and hauling up the centre board is a consideration. I have tried a centre board on an ordinary deep cutter, but she was decidedly the worse for it. I then took her leaden keel off, and shallowed her about half an inch, (she was a 2 feet cutter, with 6 inches beam and 4 inches deep), put back the keel and centre board and she sailed remarkably well, in fact was decidedly faster in light winds than when she was deeper and had a fixed keel only. I may here mention that the keel at first was 1½ inches deep, all lead, but when I shallowed the boat I shallowed the keel ½ an inch as well.

The reason I tried the experiment was, to see whether the Americans are right in their theory, that you cannot go beyond a certain depth in designing a centre board boat. I have never tried the experiment on a very narrow model, say one five times the length of her beam. I am inclined to think that the narrower a boat is (I am speaking of a deep sharp Yacht) the better she will bear a centre board, because it is a well known fact that great beam and great depth never answer together. There are certain fixed rules, and if you go beyond them, a failure is the result. Some models have been constructed with double keels, one fitting inside the other, and worked by a screw on the deck. I never attempted such an experiment myself, because it could never answer in a real Yacht, from the impossibility of getting ordinary frame work to stand the strain of a heavy leaden keel, working up and down through the kelson. I don't mean to say that it might not be attempted, but six months would be about the full period such a vessel could last. If a Yacht were constructed of such heavy and solid materials as would suffice to bear the strain of a double keel, she would be handicapped to a very great extent as against other vessels, and the

advantages which she might have from the double keel could hardly compensate for the extra weight of the framing. Our business, however, is to show the Model Yachtsman how to construct a centre board. Take the bottom piece of your model, and before fastening it to the others, saw a slit in it corresponding with a slit in the leaden keel. On each side of this slit fasten a couple of thin pieces of board ($\frac{1}{8}$ of an inch thick for a 2 feet model, and so on in proportion.) These form the sides of your trunk or box. They should be high enough to reach about $\frac{1}{8}$ of an inch above the deck, when the latter is put on. At each end of this box fix another piece; I generally make a little box, about $\frac{1}{4}$ inch or $\frac{1}{2}$ an inch high, first nailing it down, and then attach the larger pieces to the sides with rock marine glue, and small brass screws. The sketch shows how this is done. The dotted lines show where the centre board comes up in the trunk through the keel. In the next sketch the centre board itself is seen fitting into the keel. When the trunk is all complete put on the deck, cutting a place in it for the trunk to come through. It is best to have a little ledge round the box for the deck to rest on; a few screws or copper brads will then secure the deck to the box, or, to use the technical term, trunk. See that the trunk is water-tight, and well painted inside to prevent warping. Now cut out your centre board, which may be either wood or thin sheet lead. If the former, a piece of lead must be added to it, in the manner described in the chapter on weighted rudders, thus the upper half of the centre board may be wood and the lower half, lead. Now drill a hole through the keel, where you see the dot marked in the sketch, and another through the centre board at its forward end. Run a stout piece of copper wire through both keel and centre board, and rivet it; the centre board now works up and down in the trunk; a hole in the after end (upper part) must not be forgotten, and a piece of cord passes through it and must be taken upon deck through the trunk. A cleat screwed to the deck abaft the trunk will suffice for the purpose of belaying the cord, so that you can haul it up and down at pleasure. In going to windward you ought to have it down in the form shown in the sketch, but for reaching, it is better to haul it about half way up, so that only a small portion of the board projects below the keel; in a running or quartering wind, haul your centre board up altogether. Another plan I have sometimes used is, to dispense with a trunk altogether, and simply insert a piece of zinc in the keel, having two or three different sizes of zinc centre boards. If the zinc is cut out with a little projector in each of its upper corners, and a corresponding incision made in the keel, you will find





it hold well enough, but it is a bad plan, because if the model touches the ground, she bends the zinc, and then it acts as a fixed rudder or a crooked keel, causing her to steer unsteadily.

I had brought under my notice some time since a very fast double centre board Model Schooner. She was built in America, and had one centre board, just under the foremast, and another under the mainmast. She was remarkably fast on a reach with her after centre board let down, and the forward one hauled up, but did nothing to windward against a 2 feet Cutter of the English type that I had constructed. This Schooner was 2 feet 9 inches long, 7½ inches beam, and 4 inches deep, and had an *iron* keel about 1 inch deep. Her centre boards were thin sheet iron, the foremost one 6 inches long, by 2 inches deep, the after centre board 8 inches long, by 4½ inches deep. It is best to let the centre board down at an angle of about 30 degrees. Square centre boards (that is as deep forward as aft) stop a vessel very considerably. The board should certainly not be more than one-third the length of the keel. When this proportion is exceeded, it seldom acts well. I cannot better close this chapter than by quoting the following yarn in reference to the dangerous character of very wide centre board boats. A few years ago, at a Regatta held in the North of England, an American centre board Sloop of 3½ tons, was entered to contend among the small fry, and this is the account given by one of her crew of the behaviour of the craft: "The morning of our Regatta rose cloudy, and apparently not in a very good temper, and with too many white horses over the sea to promise the most suitable kind of weather for the success of our small 'lot.' We got under weigh with some misgivings as to whether she would be able to 'stand up' under it, but as we felt pretty certain the little 'Swallow' would not sink if (the ballast being in bags) she came to grief, and her crew were got up in oilskins, we all (four) determined to sail her as long the American 'muslin' would keep above water.

"The wind kept blowing fresh from N.W. by W., with a chopping sea, and in the preliminary tacks a hand was told off to keep baleing out with a bucket the frequent seas and spray which had made their way over her forecastle into the cockpit. As the time for starting approached we hardened down the third reef in her mainsail, and set the storm jib, to which we had hooked on a pair of new jib sheets. We usually sailed her with one. The second gun fired, and off we went to a flying start. The difficulty of keeping her steady to her course with such a wind and sea was no joke. Hands were changed alternately at the bucket, and when the sea did not favour us with a visit in the cockpit, the spray flew over us like dust. She fought it out bravely and determinedly till we got round the weathermost buoy first, and then we bore away dead before the wind. On looking astern, the owner, who steering, thought the weather looked dirty, but it had blown so hard during the day, that we were getting used to it—like the eels—and not so careful as we should have been. In a few minutes, through a hollow

in the mountain, down came a white squall, blowing clouds of spray, so thick that one could not see a few yards astern. The first sensation as we drove before it was, that boat and all was lifted bodily out of the water. Up went the tiller, to prevent her broaching to, and all the strength that could be brought to bear on it for the moment was not sufficient. 'Slack away the peak' was shouted, amid the roar and hissing of the spray, but too late. Her immense boom drove her round to the wind in spite of the rudder, and the new jib sheet foul'd in the block, and would not slack away. As she lay down under the squall, her crew got over her weather topside, and as she turned bottom up, sat as composedly as circumstances would permit, spectators of, but no longer participators in the race. Some of the Yachts were dimly seen through the mist passing quite close, with scarcely any sail up, but as their crews did not see us, and as we felt safe enough, we did not spoil the race by hailing them. Shortly afterwards, as the squall cleared off, we were picked up by a four-oared boat, and after an ineffectual effort to get the 'Swallow' righted, we had her towed a-shore, and here we soon, after a change of toggery, enjoyed a good dinner, none the worse for the adventure."

There, I think the reader will understand pretty well what sort of craft American centre board boats are after that. I had one about 18 feet long during part of the time I was in the States, and an odd thing she was. The only wonder is that I am still above water, considering the hare-brained attempts I made to get a sail out of the wretched trap in a breeze of wind. Some of the boatmen used to prophecy my speedy demise when they saw me getting underweigh on a squally afternoon, with two reefs down and a pile of sand bags on the floor of the little craft. Really though it was hard lines not to be able to have a cruise in weather that an English 5 ton Cutter would have revelled in, and carried a whole mainsail comfortably.

An American has invented a twin centre board boat, a specimen of which is now in the Thames, called the "Duplex." They are very fast indeed, extraordinarily so, but still they are not Yachts, and would be useless in a heavy sea. I have not tried the principle in a model, although I understand the Inventor did so previously to building the yacht itself. The great secret is in connecting the two boats together by a sort of universal joint, in fact the connections are formed by a ball and socket. Directly the frames between the two boats are made rigid, the "Duplex," as this sort of craft is styled, becomes slow.

CHAPTER XI.

MODELS OF SHIPS AND STEAMERS.

ALTHOUGH Model Yachtsmen have not much occasion for models of square-rigged craft, except for show purposes or specimens of workmanship, it is as well to understand how to fit and rig them properly. With respect to Steamers, much may be learned from them, many Naval Architects agree in thinking that the best form for steaming right a-head remains yet to be discovered. Some one in America stated a few years back, that the succeeding generation would possess steam-vessels capable of attaining a speed of 30-knots an hour. Without going so far as that, there is no doubt that every year, some slight increase in the average speed of Steamers generally is perceptible. I am not alluding to river boats, but to vessels built to cross the ocean under steam. We all know that in the United States the light draft river boats have attained a speed of twenty miles an hour, but no ocean going steamer, so far, has achieved a greater speed than 17-knots, or about nineteen miles an hour, and this only under the most favourable conditions of wind and weather. The fast Torpedo launches we hear so much about, cannot be driven at the same speed in rough water as in smooth. With respect to models, I have never yet seen a Steamer able to compete successfully with a sailing boat of equal length in anything of a breeze. I remember hearing of a wonderfully fast Model Screw Steamer, 3 feet long, which was said to steam four miles an hour. When, however, I witnessed the performance of this much overrated craft, I was convinced that a sailing model would beat her. The owner of the Steamer not objecting, a match was made, and I brought out a racing Cutter 2 feet long, not by any means a fast boat off the wind or reaching, although a tolerable good craft to windward. The course was across the Serpentine and back, and the wind nearly due west, consequently a reach both ways. The Cutter was under her three lower sails, viz., whole mainsail, foresail, and No. 1 jib. The Steamer had nothing but her steam. Her engines were double action oscillating cylinders, $1\frac{1}{2}$ inch stroke, $\frac{5}{8}$ inch bore, and a three-bladed Griffiths' screw, a copper boiler, apparently taking up the whole midship part of the boat. On starting, the steamer appeared to gather her way first, and showed slightly in advance, but the sailing model as soon as she had settled down to her work drew gradually a-head, and came in about thirty seconds before the Steamer at the finish. I do not for a moment mean to assert that a Steamer 4 feet or 5 feet long could not be made to beat any sailing model of 2 feet or even 2 feet 6 inches long, but what I mean is, that length for length a

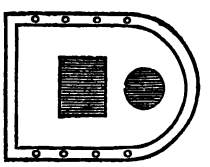
sailing model will beat a Steamer with a fresh beam wind. If the Model Yachtsman is desirous of making a miniature full-rigged China-tea Clipper, a Gun Brig, or a Barque, the following directions will do for either, provided he bears in mind that a ship is square rigged upon all three masts, a Barque is square rigged only upon the fore and main, her mizen being fore and aft-rigged, while a Brig has only two masts, both square-rigged. There are several other varieties of merchant craft, such as a Hermaphrodite Brig, which is square-rigged forward and fore and aft-rigged aft, a Brigantine, which carries topsail and top-gallant sail on her main topmast, over a Schooner's main-sail a square top-sail Schooner, &c., all of which can be better understood from the cuts in the appendix.

A very good type to make a square-rigged model from is given in the diagram plate 4, and a description of how to make and fit her sails and gear, will give the Amateur sufficient insight into the requirements of square-rigged craft as will enable him to rig and fit any other kind of vessel.

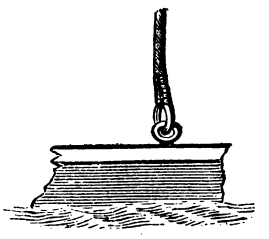
First comes the model. Now the vessel alluded to is intended to overcome the difficulties which lie in the way of opening up new sources of trade for sailing vessels. It will be perceived that the diagram represents a vessel five times the length of her beam, with a depth of half her beam, and round full-bottomed midship section, with great tumble home in the sides. A model constructed on that principle would sail fairly well, even rigged as in the drawing. Of course a Cutter, Schooner, or Yawl half her size would beat her easily, but still it is a question whether for a square-rigged vessel you could better it. The usual type of square-rigged merchant ships has more of a box section, as in fig. 2, plate 4. The advantage this is supposed to possess over the other, is comprised in the greater capacity for stowage. This advantage is, however, not so great as at first appears. For instance, taking the two sections already alluded to as representing two vessels of precisely the same length, breadth and depth, No. 2 would perhaps carry, to bring her down to the marked line, about one-fifth more weight than No. 1. A glance at the diagram, however, shows that No. 1 above the marked load line has considerably more spare buoyancy left than No. 2, consequently she must be safer and handier in a sea way, provided all other things are equal. Indeed it is a question whether No. 2 would be allowed to go to sea loaded to such an extent. I have made these remarks, in order that the Amateur designer should have a clear comprehension of the meaning of the terms "over-weighted", or "over-loaded." A vessel may appear to the eye very deep in the water, while in reality she is only in proper trim, in fact just down to her bearings. Provided a vessel has enough spare buoyancy left to enable her to carry her sail properly, without burying bodily under water, she cannot be considered an overloaded vessel, although she may not be in her best sailing trim. A model and also a real vessel sails best with her bearings just below the water line,

because she is then *water borne* at the point where her greatest buoyancy is placed. The deck line should not exhibit any flatness in the sides, but be gently curved fore and aft, as in the diagram. A leaden keel is of course indispensable, if the model is intended for sailing purposes. With regard to the rigging, the foremast should be about one-third the length of the model over all, the mainmast just half the length over all, and the mizen mast the same length as the foremast. The fore and main top masts may be of equal length. The mizen-top mast about two-thirds the length of the others. The bowsprit should be equal in length to the mizen mast, measuring from the deck to the cross-trees, and the jibboom may be the same length as the bowsprit. The proportions of the thicknesses of the masts are as follows: mainmast about one-twelfth the beam of the model in diameter, foremast slightly less, and mizen-mast a shade slighter than the fore-mast, bowsprit the same thickness as the mizen-mast. The top masts are, of course, made in proportion, and tapering. Now the vessel shown in the diagram is called a "Jackass Barque," if she had no mizen-mast she would be a Brigantine. A "Jackass Barque" differs from a Barquentine, in having a square topsail at the main, whereas a Barquentine has only fore and aft sails abaft her foremast.

We will now proceed to fit the lower masts. It will be perceived that the foremast differs from the mainmast, in having a very much larger cap for the heel of the topmast to step in. This in a square-rigged vessel is called "a top." This top may be made of hard wood, ivory, or thin sheet metal. The head of the fore-mast is squared, and the top fitted on through the square hole, the round hole pointing towards the bow. Short pieces of wood may be nailed on the mast underneath it, to keep it from slipping, to which it may be pinned or nailed. The upper cap may be made in the same manner as described for a Cutter. The head of the fore-topmast must be also fitted with caps for the top-gallant mast to fit into. The length of the fore-top-mast and top-gallant mast combined should not, when placed in position, overtop the main topmast, but be a little less in height. Cross-trees, short pieces of either metal or wood, must be placed on the lower cap of the fore-topmast, to extend the top-gallant shrouds. The bowsprit should not have more steve or cock up than the sheer of the vessel. Strong oak or mahogany bits, cut square, should be screwed to the deck, and the heel of the bowsprit fitted into them, and kept in its place with a wire fid. The jibboom goes into caps or wire rings on the bowsprit; these caps must allow the jibboom to pass easily out and in. The mainmast and mizenmast are fitted in the ordinary fore and aft manner. Next comes the operation of rigging, but first as to the spars. There are three yards on the foremast, and two on the mainmast. The lower yard on the foremast is called the foreyard, the one above it the fore-topsail yard, and the next highest the fore-top-gallant



yard. Some square-rigged vessels carry royals above the top-gallant yard, and skysails above the royals, but they are not necessary in a model. The mainmast of the "Jackass Barque" has a topsail yard and lower yard only. These yards should be about the same thickness in proportion as the masts they are fitted to. The top-gallant yard of course being the slightest, and the lower yard the stoutest. These yards are fitted to the masts by means of what is called a parral. A piece of wire is bent round and fixed to the middle of the yard; this goes round the mast, and can either be twisted round its own part, or made to go with a hook, if required to take apart easily. To keep the yards in position lifts are necessary, which should go from the yard arms, as the ends of the yards are called, to the fore-mast head in the lower yard, and to the topmast and top-gallant mast heads for the topsail and top-gallant yards. The fore and aft mainsail works on a boom fitted into a goose neck, as described in rigging a Cutter, and the spanker, driver, or mizen boom (for it goes by all three names) also works on a goose neck. The gaffs can be fitted with either wood or wire jaws, and the mainsail and mizen are fitted with wire hoops to travel up and down the respective masts. If a completely rigged model is desired, channels may be made to attach the lower shrouds to. Some modern vessels dispense with channels altogether, and have what are called "chain plates" instead. The latter are much the best, as they do not disfigure the vessel's side, besides in a craft where speed is essential, channels are a sad nuisance, directly a vessel heels over sufficiently to put them in the water they stop her way materially. If channels are required they should be made of hard wood, and screwed on to the vessel's side. Four screw eyes on the fore, three on the main, and two on the mizen channels suffice for the shrouds, but I should prefer putting these screw eyes into the top of the rail or bulwark, and dispensing with channels altogether. The rigging goes over the lower mast head in a loop, and the ends brought down to the eyes in the rail, passed through them, hauled taut, and seized to the standing part thus. The yards should have braces fitted to them, so that they can be kept at any desired angle. The braces should be of lighter cord than the standing rigging, one end made fast to the yard arms, the other except that leading from fore yard taken into the mainmast, passed through a screw eye, and led down along the mast to the deck and belayed to a hardwood cleat, screwed on to the deck in the wake of the mast. The fore braces lead to the main rigging, one on each side, and are made fast to cleats screwed just inside the bulwarks. The main topsail brace leads to the mizen topmast head, while the fore topsail brace leads to the main-mast head and the fore top-gallant to the main topmast head. I am speaking now of the vessel rigged as in the diagram, plate 4.



In a full-rigged ship the braces lead differently, but a study of the diagrams, plates 7 and 8, and their explanations will show the Amateur Model Maker how to fit his running gear better than any description. It will be observed that the "Jackass Barque" has her fore and aft stays fitted in a peculiar manner, this is in order that the three masts shall be independent of each other. I gain support for the mizen mast by placing its foremost shroud much further forward than is usual, and the stays lead down to the deck. These in a real vessel would be double and set up with tackles, so that the lee one could be slacked off and the weather one hauled taut, in the same maner as a Yacht's runners and tackles. The fore topmast rigging goes over the topmast head, and then down through the holes in each side of the top, and is taken into the lower masthead, just above the sling of the fore yard. Three screw eyes in the head of the foremast on each side will suffice to make fast the topmast rigging. The top-gallant rigging comes to the crosstrees, and is taken underneath them in the same manner. The main and mizen topmast rigging is fitted in a similar manner as the fore top-gallant rigging. The main and mizen sheets should both work on brass traverses, screwed into the deck with brass screws. They are easily made, the ends of the wire are merely turned round to form an eye, and the screw passes through them to the deck. There should be a fore-stay leading to the bowsprit at the gammon or cranch iron, which ought in a model to be brass, and a fore topmast stay to the end of the bowsprit. Another stay, leading about half way out on the jibboom serves for the flying jib, and the fore top-gallant stay serves to set a jib topsail, or more properly speaking a fore top-gallant stay sail. With regard to the sails, the square sails should be cut with selvage along the head and foot. The fore and aft sails cut as described in the earlier part of the book. The main and main topmast stay sail are set flying like a Cutter's jib, but the fore stay sail, jib, flying jib, and jib topsail are set on the stays. A couple of reefs in the main and mizen sails, and also in the head of the fore topsail will also not be out of place. A model of this description and rigged carefully ought to sail very fairly, and on a reach or with the wind a point or two abaft the beam, hold her own with a fore and aft Schooner, but directly she is close hauled the square sails tell fearfully against her, and the Model Yachtsman will do well not to risk his reputation by pitting her against craft constructed solely for racing purposes.

In constructing a Steamer, the first consideration is whether she is to be propelled by a screw or by paddles, because in the latter case the model may be made broader, and shallower than for a Screw. The diagrams, plate 5, will give the Model Yachtsman a very good idea of the sort of craft suitable for a Steamer. The bottom should be flat, or nearly so, and the floor carried well up into the ends. Some authorities hold that a Screw Steamer ought to have a very powerful after body, because, that not only allows for the placing the engines well in the stern, thus leaving a much larger portion of the boat free for cargo or

cabin accommodation, but also for the reason that it permits the designer to lengthen out the bow to extreme fineness, thereby increasing the speed very materially. Now there is no doubt that a vessel with the greatest body, one-third from the stern, with a very long bow, can be made to steam ahead very fast indeed, and were speed the only consideration, I should advise the Model Yachtsman to build his Screw boat accordingly; but there is another desideratum which must not be lost sight of, and that is steadiness. Vessels with a very full after body, in comparison with their fore body, are notoriously unsteady, and what little they gain in speed is lost by reason of the extra water they travel through in their somewhat erratic course. Therefore make your model boat on equal displacements, whether intended for sail or steam, is the advice I offer. A Steamer should not be entirely dependent on her steam alone, because if she breaks down in the middle of the lake, river, or pond she is navigating, much time may be wasted in recovering her. To obviate risks of this sort, a small jib should be set, balanced by a small mainsail, or if she has three masts, a mizen, or spanker. This canvas should not be large enough to blow her away from her course while under full steam, but just sufficient to blow her ashore in case of a break down. If she is a boat of great beam, say three and-a-half to four times the beam for the length, her boilers and engines will give her sufficient stability to stand up to such small sails in ordinary weather, but if long, narrow, and deep, she must have a small leaden keel, not more than $\frac{1}{4}$ inch deep for a 2 feet, and $\frac{1}{2}$ inch for a 3 feet model. Before she is decked, the space not occupied by the engines should be made water-tight, by having two bulkheads, one cutting off the fore part of the boat, and the other the after part, so that when the deck is fastened on, those parts of the boat are perfectly water-tight. This is necessary because the engine space must be kept open, in order that the lamp which heats the water in the boiler may be trimmed, and the engine gear attended to and kept clean. With respect to the engines themselves, the Amateur cannot do better than purchase the cylinder, screws or paddles at one of the Model engine makers, because they require to be made with such nicety that only an experienced hand can turn them out satisfactorily.

The following is a very rough and ready way of making a steam-engine. Get a piece of brass tubing about $\frac{3}{4}$ inch diameter, and $2\frac{1}{2}$ inches long, and get a tin-smith to solder up one end, or if you like and are mechanic enough you can do it yourself, then rub a little common black lead round the inside of the tube, and on the soldered part. Now take a piece of wire and flatten out one end of it like a rivet, this can be done by putting it in a small vice, and tapping the end with a small hammer. Place the tube upright, and with a little white lead or gold size putty, stick the rivetted end of the wire, it should be a stout piece of brass wire, on to the soldered part inside the tube, of course taking care that it is exactly in the centre of the tube. Melt some lead, and pour in sufficient to cover the bottom of the

tube to the depth of ⅛ of an inch. When cold, by pulling the wire the piece of lead will travel up and down the tube smoothly and evenly. A piece of brass must be fitted over the open end, and soldered on to prevent the lead from coming out, a hole being left for the wire to pass through. The brass tube is now a cylinder, the wire being the piston-rod. Now get a tin box made at the tin-smith's, about 8 inches long, by 4 inches square, have it made of good stout block tin. A metal rod, 2 inches long, at each of the lower corners must be added, these are to allow space for the spirit lamp underneath A hole in the top, with a screw cap, is for pouring the water in.

To fix this for working, have a sheet of thin brass, zinc, or copper to line the engine space of your boat. This should come right up to the deck on each side, with pieces at each end. Screw the boiler legs, they ought to have little feet with holes in them, into the bottom of the boat through the metal lining. Before doing this, however, a flat piece of metal must be soldered underneath the after end of the boiler, projecting from it about 1 inch, this is for the cylinder to rest on. The cylinder must be soldered on to this metal slab. Before soldering it on, make a hole in the boiler big enough to take a piece of metal tubing ⅛ of an inch in diameter. This tube must be soldered into the boiler and also into the cylinder, which must have a hole in it to take the tube exactly opposite to that in the boiler. This first tube must be at the bottom of the cylinder ; about two-thirds up on the side opposite to the boiler, another tube may be soldered on the cylinder, and led out through the side of the boat. The end of the wire piston must be made into an eye with the pliers, and another short piece of wire made fast to it in the form of the letter Z. This goes on to the spindle or paddle shaft. Fill the boiler with water, and place underneath it a common spirit lamp, which can be bought at the oil shops. When the steam is well up, give the paddles a spin round, and if ordinary care is exercised in carrying out the foregoing instructions, the apparatus will be found to work fairly well. It can be applied to a Screw boat by turning the cylinder round, and having a long screw shaft, with an universal joint in mid-length. Of course in Screw boats, a bearing, a tube of brass or copper, must be fitted into the aperture in the stern-post, through which the screw shaft projects, and all round the shaft melted tallow must be poured, which acts as "packing" or stuffing, and keeps out the water.

There are other ways of propelling a model, notably by clock-work, which is made expressly for models by skilled workmen. The best place to obtain clock-work engines is in Clerkenwell. A good clock-work engine, which will drive a boat 3 feet long, costs about 35s. direct from the makers. The Model Dockyards charge a little more.

A very powerful engine may be made as follows :—get an India-rubber door spring, and fasten one end of it to the bow of the boat ; now fit a strong cord to the loose end, and bend it to an iron spindle placed at the stern, on which a large cotton reel has been fixed. Lead

the cord round this reel, and take it to another iron spindle near the paddle shaft, having on it also a cotton reel. This spindle, one end of which projects, must have a brass cog-wheel working in another cog-wheel, fitted on the paddle shaft. The part projecting from the side of the boat must be square, for a key to fit in to wind up the India-rubber spring until it is stretched to its fullest extent. Place the boat then in water and let go. You will be astonished at the amount of power there is in this simple contrivance. Unless the spindles are all pretty strong they will break under the pressure.

However, if the Model Yachtsman desires to become a Model Engineer as well, he must purchase a work on the Steam Engine, our space is too limited to go into the merits of slide valve engines, oscillating cylinders, horizontal and vertical, steeple and beam, and all the other questions connected with marine engineering, which are, after all, of not much practical use to the Model Yachtsman.

CHAPTER XII.

HINTS ON DESIGNING.

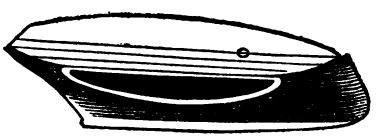
THE WAVE WATER LINE THEORY—BUTTOCK LINES—SMALL AND LARGE DISPLACEMENT—DEEP KEELS—SAIL-POWER.

IN the foregoing pages I have touched but little on the principles of good designs, for the reason that it is better for a beginner to master the mechanical part of Model Yacht building and sailing, before worrying his brains with the more abstruse problems connected with naval architecture. After the Amateur Model Yachtsman has become thoroughly acquainted with the practical part, he may turn his attention to designing for himself.

In the remarks I have to offer in this and subsequent chapters, I by no means wish to be understood as laying down the law in regard to the best form of vessel for speed and weatherly qualities. On the contrary, my ideas are put forward with great diffidence, at the same time, the long experience I have had in model yacht sailing, emboldens me to speak out, even at the risk of being challenged by some of the great luminaries of modern naval science.

In explaining the elements of careful designing, I will begin with the wave line theory. It is some thirty years since Mr. J. Scott Russell

first put the results of his experiments with wave line models prominently before the nautical world. Since then his theory has had ample trial, and to this day opinions are very much divided as to whether Mr. Scott Russell is correct or not. It would take up too much space to go into all the arguments on the matter *pro.* and *con.* No doubt for steaming straight ahead "wave water lines" are excellent, but in a sailing vessel, there are other considerations to be taken into account. Now what is Mr. Scott Russell's theory? Divested of its technicalities it may be briefly rendered thus :—an elongated letter S for the bow joined to a shorter S for the stern; the proportions being as three to two, at least this, if I remember rightly, was the rule laid down by Mr. Scott Russell at the meeting of the Institution of Naval Architects in 1861. This diagram shows the wave water line. That there is some merit in the wave water line it is impossible to deny, seeing that several successful Yachts are constructed on Mr. Russell's principle; but whether it may be considered as the true form of least resistance, so far as sailing vessels are concerned, is doubtful Indeed a careful study of the lines of the most celebrated Yachts which have been built during the past twenty years, shows that wave water lines are not of so much consequence as Mr. Scott Russell would have us believe they are. The Schooner, *America*, a vessel which has been often put forward as an exemplification of the "Wave Water-line theory," has the load water-line of her after body nearly straight, as indeed have many other very fast vessels, and the *Jullanar*, certainly a vessel of great speed, has every one of her water-lines, fore and aft almost straight. The fact is, a careful study of the question coupled with numerous experiments, has led me to the conclusion that the form of the horizontal lines of a vessel, by which are meant, water-lines, are not nearly of so much consequence as the form of the "buttock lines." "Buttock lines" are lines drawn round a vessel perpendicular to the horizontal lines. In fact, they represent the form of a vessel divided longitudinally into perpendicular slices. The sketch below represents a Model Yacht, with a piece of her side sawn off about one-third inboard from the outer edge. The shape of the lower edges of a series of slices so taken off are what are termed "buttock lines." Of course the shape of these can be accurately marked off, without spoiling your model. The sketch of the sawn side is merely to enable the Amateur to comprehend at a glance what are meant by "buttock lines." There are other lines, called "futtock lines," which represent the form of a vessel with pieces sliced off horizontally at certain angles of inclination. Lord Robert Montague, M.P., some years since published a work on Naval Architecture, in which he says, "that the form of



the chief dividing line is the most important point in the construction of a vessel." Now Lord Robert Montague's chief dividing line is nothing more or less than a futtock line. He expresses himself thus with regard to what he then considered a new feature in Naval Architecture :—

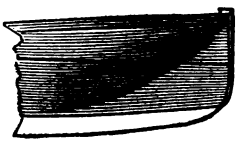
" Those mathematical formulæ which had relation to vessels at rest, are unaffected by the present theory, but those of which the subject was the motion of a vessel through the water, must all be altered. For they were calculated on the *assumption that the water passed along the surface of the vessel in the direction of the water lines*, or in horizontal planes, while, in fact, the curve which any particle of water would describe *is totally different.*" The italics are my own. If this is true, and certainly my experience leads me to the conclusion that his Lordship is correct in his surmise, what becomes of the " wave water-line " theory ? I remember seeing an old gun brig on shore in Table Bay, Cape of Good Hope, and was told that she had beaten everything she ever fell in with ; even the fastest Yankee Slavers could not get away from her directly it came to a close haul. Her bows were bluff, and she was a clumsy looking craft above water, but underneath she was a picture. Her lines under water, made one continuous unbroken sweep from cutwater to rudder post. An American three-masted Slaver, with a wave-line bow and stern, which the brig had captured was lying on the beach close to her, and it was easy to see the superiority of good buttock lines over indifferent ones, even when the latter were coupled with " Wave water-lines."

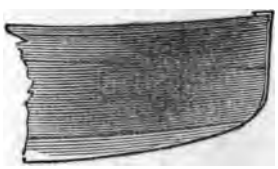
A model with fair easy buttock lines, although she may be bluff and clumsy will sail faster than a sharp-bowed model with bad buttock lines. Provided the bow be fine below, it does not so much matter if it is full on top. How many real Yachts have been improved by having their bow timbers fined away under water. Take the celebrated *Thought* for instance, when she first came out she was considered a failure, but Dan Hatcher, of Southampton, took her in hand and altered her considerably below, in fact improved her buttock lines. The result was eminently satisfactory, as she became one of the fastest 27-tonners afloat, in fact no other vessel of her tonnage with the exception of the *Phantom* could master her for years.

In the remarks I have made on Mr. Scott Russell's wave water-line theory, I do not wish to be understood as implying that wave water-lines are bad in themselves. On the contrary, the long hollow bow which the wave-line gives a vessel, is no doubt, highly conducive to speed, but at the same time the horizontal lines in a sailing vessel are of less consequence than the buttock lines. With proper buttock lines a craft may also have the wave water-line, and will doubtless be all the better for it. Care must be taken, however, not to get the after body too short, which will be the case if Mr. Scott Russell's proportions, 3 to 2, are adhered to, because it tends to make a model unsteady.

The annexed diagram shows the difference between good buttock lines and bad ones. The hollow lines fore and aft are very detrimental to speed. They not only increase

the area of "wetted surface," but if the after lines are taken up with a concave curve, a wave is formed under the vessel's stern on the lee side, which makes her run off her helm. These buttock lines should form the segment of a circle. In fact, the nearer they approach to the segment of a circle the faster the model will move through the water. Those near the keel will be steeper than those at the bilge, but still the same contour should be preserved. In designing a model, first draw the deck line or half breadth plan, then the sheer plan or side view of the little craft, lastly draw the midship section. Now divide the deck line and sheer plan into a number of equal parts, and mark where they come on the body plan and rule them down. Carefully draw in the shape that you think each vertical section should be, making one half of the body plan the stern, and the other the bow. Rule off on the half breadth plan a series of straight lines, parallel with the middle line of the deck, three will be sufficient, and rule these down the body plan. Now measure off the places were these lines cut the fancy sections on the body plan and mark them on the sheer plan. If you find they do not make a fair sweep fore and aft, alter the sections until you get them correct. Last of all put in the water or horizontal lines, which are sure to come right provided the buttock lines are correct. This is a very simple and easy method of designing a fast model. It matters little whether the midship section is round, hollow, or straight, the buttock lines *must be carried up fore and aft*, with a gentle easy curve. The bow need not come into a mark like the annexed sketch, but should be hollowed thus, the lower part near the stem almost jammed together. With respect to the run it should approach as nearly as possible to the form of the bow, and the straighter the water lines in the after body, (always keeping in view the sweep of the buttock lines,) the better.

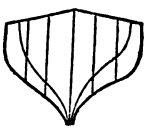




Another question which must be taken into account in designing a model is, whether she shall be of large or small displacement. Every floating body displaces a certain amount of fluid, and the quantity of the water displaced weighs exactly the same as the vessel so displacing it. It is a mistake, however, to suppose that because a vessel has a very small displacement in proportion to her size, that she must be fast. I have tried hundreds of experiments in this direction, and have invariably found that a large

displacement model of the same length, depth and beam as one with a small displacement, will beat the latter, especially in going to windward. I believe Mr. Dixon Kemp, in his admirable work on "Yacht Designing," has given the right reason for this, where he speaks of a large area of "wetted surface" being detrimental to speed Perhaps the non-technical reader may be slightly puzzled at the term "area of wetted surface," so a little explanation may not be out of place.

Suppose that the sides of a vessel were composed of two thin sheets of tin, or any other metal, then if these sheets of tin were hammered out flat, they would represent the "area of wetted surface." Now a vessel with very small displacement, would necessarily require a much larger sheet of tin to cover her than one of the same length, breadth and depth, but with fuller lines. For instance, here are two sections, the same beam and depth, but one has more area of wetted surface than the other.



Now, as already described, the water has an inclination to adhere to even the smoothest surface, and the larger the surface, the more numerous must be the particles of water endeavouring to cling to it as it passes through them. It is therefore obvious that unless the motive power which is used to drive the larger area of wetted surface through the water, is greatly in excess of that used for driving the smaller area; the latter will move more quickly, as a less number of particles of water can stick to it at the same time. Very concave or hollow vertical sections give a much larger "area of wetted surface" than either convex or straight sections. Then again, it must not be forgotten that in order to give the requisite sweep or spring of the futtock and buttock lines, slightly hollow, vertical sections may be absolutely necessary. A model should therefore be so designed that the concavity in her vertical sections does not extend *more* than one-third the length on the load water line, from either end. Where there are no restrictions on the length of the model, in designing a vessel to sail by tonnage measurement, for instance, I am aware that this rule admits of some modifications; but even in that case, the less dead wood there is, always excepting the lower part of the heel and gripe, where the planks should be, nearly, if not quite, jammed together, the quicker the vessel will be, especially in moderate winds. Some Model Yachtsmen have conceived the idea that a very shallow body, with an enormously deep keel, is the correct thing. The lead being placed on the bottom of this keel enables such a craft to stand up to the most outrageous sails. Still, owing to the large extent of wetted surface, such models are failures. They cannot be made to sail to windward, for the reason that the amount of canvas necessary to drive them with any speed, is so out of proportion to the lateral resistance that they blow bodily to leeward. The lateral resistance must not be overdone. One of those curious problems in naval architecture which the scientific schools have tried in vain to solve, is contained in this. All other

things being equal, it is fair to suppose that a small increase in the lateral resistance will have the effect of making a vessel more weatherly, but strange as it may seem, in some instances it has the very opposite effect. An American yacht-builder told me, on my remarking the smallness of the centre board of a certain sloop, "Well, I guess she won't sail with a larger one; we've tried her every way, and she a'int kind nohow, except with that 'ere board." Some models will bear a deeper keel than others with advantage, but it depends very much upon the form of the craft. A very full, round boat will bear a deep keel better than a fine cutaway craft. Again, with a very round fore foot, and a great rake to the stern-post, the keel may be deepened aft with advantage. It has been said that great drag, as the excess of the draught of water at the stern over that at the bows, is called, is detrimental to speed; and so it is when carried to an outrageous extent. A fair amount of heel or drag is, however, rather desirable than otherwise, and the shorter a vessel is on the keel, the greater may be the excess of draught of water aft over that forward. With respect to the form of the deck line, I believe what is known as the "Bird Shape" to be the best. There should he no "straight of breadth," that is an equality of width along the side, anywhere. A gentle curve from the stem head to the taffrail, which last should be narrowed into about half the beam, is the best deck line for a model yacht.

Some letters have lately appeared in "*The Field*" and other journals with respect to the proportions of beam to length for model yachts. Of course, where the limit of length is used as a standard whereby to class them for racing purposes, it is impossible to construct a model of the proportions, say of *Jullanar*, to contend successfully against other craft of equal length, but actually double the size. At the same time, I have seen, on more than one occasion, a model, five times the length of her beam, beat one three-and-a-half times the length for her beam, and that in a strong breeze. My own idea is that about four to four-and-a-half times is the limit, beyond which it is dangerous to go, when length alone is used as a rule of measurement. The proportions of depth to beam vary in accordance with the form of the midship section. In no case ought the depth, taken from the bottom of the model without the keel to the deck, to exceed the beam. In fact, a very fair rule is to make the depth amidships to the deck, counting keel, equal the greatest beam. This is about the best proportion for speedy all-round sailing.

I now come to the consideration of the sail power of models. As already stated, the best rig for all round sailing is the Cutter. Some models I have seen sail wonderfully well with only one large sail, something between a lateen and a lug. It depends however very much upon the form of a boat as to how she should be rigged. A model with excessive beam will sail better as a Yawl or Schooner than as a Cutter; she may not perhaps lay quite as close to the wind, but in reaching she will be much faster with the motive power low and

spready, because it steadies her. A long narrow model on the contrary will sail better as a Cutter, and will even reach faster. I know these few remarks are somewhat antagonistic to all pre-conceived notions on the subject, but as they are the outcome of practical experiments, I put them forward, because they can easily be tested, and I have no fear as to the result. There are several things to be taken into account in rigging a model. The first thing is to find out the right position for her mast or masts, next the shape or cut of the sails, and lastly the position of the centre of effort of the sails. All vessels when afloat have what are called four centres or pivots. First, the centre of gravity, which is the exact centre of the weight of the hull, her spars, rigging, sails, &c.; second, the centre of buoyancy, which is the exact centre of the shape formed by that portion of the hull which is under water; thirdly, the centre of lateral resistance, the point or centre from which the vessel can be moved sideways without diverging from a straight line; and last, but not least, the centre of effort, or the point where the whole motive power of the wind acting upon the sails is concentrated. Now it is self-evident, that unless the centre of gravity is much lower than the centre of buoyancy, the model would capsize. Therefore, a very low centre of gravity is absolutely necessary, hence the reason for a heavy metal keel. If the centre of buoyancy is too far aft or forward, there must be disproportion between the ends, which will effect the steadiness of the model in sailing, hence the necessity of an equal amount of displacement fore and aft. If the centre of lateral resistance is too far forward, the model will gripe so much that there will be no steering her, and if too far aft she will run off her helm, and not come to the wind at all. Now the centre of effort of the sails is very often made to act against the centre of lateral resistance, when the latter is wrongly placed. The consequence is, that the model can never be relied on, because sometimes one force, and sometimes the other gets the upper hand, and accordingly as this occurs, so does the little craft deviate from her course. If the centre of effort of the sails is too far aft, their tendency is to drive the boat into the wind, if too far forward away goes the bow. Therefore it stands to reason that where great speed is desired the three centres, namely, the centre of effort, the centre of buoyancy, and the centre of lateral resistance should all coincide, or, in plainer language, be as nearly as possible in a line with each other. The centre of lateral resistance can be easily arrived at by putting a mast in the middle of the boat, and pulling her broadside on without a jerk, and by shifting this mast backwards and forwards until the boat does not swerve either to the right or left, then the mast is exactly over the centre of lateral resistance.

To know how to proportion the sails so that their centre of effort shall be exactly over the centre of lateral resistance, is arrived at by shipping the mast made in accordance with the rule in Chapter 5, in the exact spot over the centre of lateral resistance, then ship a spar

in the stern like a yawl's bumkin, and another forward, these spars should be one-and-a-half times the beam of the boat in length; thus, if she is 6 inches beam, these spars would be 9 inches. Tie a piece of cord to the masthead, and make it fast to the bumkins at each end. The two triangles formed by this piece of cord and the mast, act as guides for cutting out two paper sails of the same shape. Take the forward one, and cut out the jib and foresail from it. There will be a piece off the after leach of the foresail, which goes on to the after leach of the mainsail at the head, *not the foot*. The eye will tell you, when the mast is shipped in its proper place, whether the preponderance of canvas is abaft the centre of effort or before it. This is rather a rough way of devising a sail plan, but it is near enough for all practical purposes.

Lord Robert Montague says that the centre of effort of the sails should not be situated higher above the load water line than a certain point, which he calls the "point velique." This, he finds, by placing a mast in the middle of the model and pulling her smartly towards him with a string fastened to the mast, but without a jerk. If her bow depresses, he shifts the string lower down the mast. If the stern is depressed and the bow rises, shift the string a little higher up the mast, and so on until the model can be pulled ahead quickly without either bow or stern being depressed. The spot where the string is fixed (when this occurs) he calls the "point velique," and this point he considers should be the height of the centre of effort of the sails above the load water line. I presume his lordship means the three lower sails of a cutter, or the four lower sails of a schooner, because, when the topsails are set, it of course, raises the height of the centre of effort of the sails. In model sailing, I am inclined to think that the "point velique" does not so much matter, because the height of the centre of effort of the sails is altered in lessening or increasing the sails, and therefore the main endeavour should be to keep it directly in accord with the centre of lateral resistance. As before stated, every good model or real vessel has a tendency to screw into the wind when pressed over on her side, by the force of the wind acting on the sails, from the increased area of the water line on the lee-side, and consequent lessening of the weather, or, in technical language, the *emersed* water line. The shape of the vessel on the lee-side is styled by naval architects the *immersed* water line; directly, however, she returns to her upright position, the balance is restored. A very small weighted rudder, as described in the chapter on "Sailing," will suffice to keep her steady, and, indeed, a model loses nothing, when sailing to windward, by screwing into the puffs, because she lessens the force of the wind, and consequently does not make so much leeway as a model which is exposed to the full power of the squall.

CHAPTER XIII.

CRUISING.

SMALL YACHTS—THE BRIG RIG—NIGHT SAILING—UTILITY OF THE LEAD

"OF all the amusements entered into by the nobility and gentry of our island, there is not one so manly, so exciting, so patriotic, or so national as yacht sailing . . . . . At sea we do meet with rough weather at times; but for roughing it out, give me a *Yacht*," so wrote Capt. Marryatt, forty years ago, and were that gallant officer alive now, his enthusiastic admiration for our pleasure Navy would be gratified by the sight of a fleet of Yachts, that are, as specimens of Naval Architecture, second to none in the world. At the date when the lamented Author of "Midshipman Easy" penned the above words, yachting was only just beginning to come into notice, as one of Great Britain's national pastimes. The Royal Yacht Squadron, it is true, was then some quarter of a century old, but the sport was confined chiefly to the aristocracy, or those whose wealth enabled them to compete with the titled nobility of the land, in such an expensive amusement as yachting was then deemed. The majority of the craft then flying the white ensign were modelled much after the style of the Revenue cruisers of that date. High at the bow, low at the stern, sides overhanging the water, with a profusion of gilt work and ornamental painting, were their chief characteristics. They carried guns too, not the toy cannon sometimes seen on the deck of a modern Clipper, but good solid 4, 6, and 9-pounders, meant for use besides ornament, for those were the days when "burglary on the high seas" was thought rather profitable, and a richly found Yacht was considered as a prize worth having by the Captain Kidds and Paul Jones of the period. It must not be supposed, however, that the humbler classes did not take an interest in aquatics, at the time we are writing of. Boat sailing for pleasure was carried on round the coasts of Great Britain and Ireland long before the Royal Yacht Squadron was ever thought of. The Cork Water Club, the original of the Royal Cork Yacht Club, established 1720, had regular Regattas for prizes, much the same as they do now, in the beginning of the last century, still no craft under 30-tons burthen, was dignified with the title of a Yacht, and the Squadron even to this day, make the possession of a vessel of not less than that tonnage one of the qualifications for membership. In old marine dictionaries, a Yacht is described as "a vessel of State, used to convey Princes, Ambassadors, and other great personages from one kingdom to another."

The word Yacht originally came from Holland. The Dutch East India Company sent as a present to King Charles the Second, one of their fast galliots, or a yacht as it was styled, and the King was so delighted with the performance of his craft, that he became quite a yachtsman, and he matched one of his Yachts against a frigate-built boat belonging to his brother, the Duke of York.

In the diary of John Evelyn, there is a short summary of this, the first Yacht match on the Thames. The course was from Greenwich to Gravesend and back. The stakes, £100. The start took place on October 1st, 1661. The King sometimes steered his own craft, and no doubt the Duke of York, who was, by the bye, a thorough sailor, also took a trick at the helm of his own vessel. Turning to windward, the frigate-built boat got the best of it, but coming back before the wind, the Dutch craft took a decided lead, and won the race. It is not recorded whether a return match was made. There was no Yachting Magazine in those days, and unfortunately the *Field* and other Sporting Journals had not come into existence. Indeed, up to about the year 1835 very little publicity was given to yachting subjects by the public Press. At the present time, scarcely a Sporting Journal in the three kingdoms is without its regular yachting correspondent, and the strides which yachting has taken in popular favour, was evidenced by the fact that at the International Yacht race, from Havre to Portsmouth, in 1874, a whole posse of special reporters were sent to France by the British and American papers.

There can be no question but that yachting as a sport cannot be enjoyed in such perfection as round the Coasts of the British Isles. Nearly every important harbour has its Yacht Club, where the stranger Yachtsman is, with one or two exceptions, sure of a hearty welcome. There are also plenty of opportunities of trying the speed of your vessel against other craft, and even if the Clippers of the day are too much for you, you are sure to meet with some vessels slower than yourself, and it is a very poor craft indeed whose owner cannot boast of having weathered upon somebody or other in the course of a month's cruising.

Many persons with an absorbing love for aquatics, but whose incomes are rather limited, have been debarred from yachting, under the idea that it is a most expensive amusement. In reality, however, Yacht sailing is one of those sports which can be indulged in with a maximum of pleasure at a minimum of cost. I do not mean to say that a crack 20 or even 10 ton racing Cutter could be kept afloat under at least £200 to £300 a-year. Those whose annual stipend is under £500 a-year had better not think of going in for match sailing, but those who are contented to enjoy a month's holiday on board their own tight little ship, with an occasional Saturday afternoon's sail, or a run to Boulogne and back, may do so at a very moderate expense indeed. The first consideration is the vessel herself. The columns of the *Field, Land and Water*, and *Bell's Life*, will show a goodly number of

craft of all sizes, shapes, rigs, and prices from which to choose. Some are described as splendid sea boats, fitted up regardless of expense, with hints as to some fabulous amount being expended on them lately, price only £_____, naming some ridiculous sum, which is quite sufficient to tell the practical Yachtsman that the craft so advertised is next to worthless. Again, there is the well known stereotyped advertisement, "Yachts from 5 tons to 500 tons for sale or hire, list post free." And when the list is obtained and a particular vessel inquired for, the answer is invariably, "just let, or sold, but we have another exactly like her to suit you." By far the best course for the Amateur Yachtsman is (if unable to build) to advertise his wants himself, and then get a practical friend, on whose opinion he can rely, to go with him and overhaul any likely craft that is submitted to him. A very good little Yacht, say from 5 tons to 7 tons can be picked up occasionally for a fifty pound note. Of course such a boat must necessarily be rather ancient, but it does not follow that she is unsound on that account.

A friend of the writer some years since bought a 6-ton Cutter, a bargain (I think he gave £35 for the boat,) laid out some £20 on her, and she lasted him through three or four seasons, during which time she twice took him across the Channel. The first thing to be noticed on buying a Yacht is the condition of the timbers where the ballast is stowed, especially if the said ballast be iron. If there are any rotten places in the timbers in which iron rust has penetrated they are easily discovered, because they will present a charred appearance. A chip cut off here and there with a knife, in suspicious looking places will at once show the condition of the wood. Next observe whether the planking is sound. Go carefully over the outside of the vessel and examine whether there are any patches over the butts to hide splits. See that the decks are tolerably sound and well secured, and last, but not least, carefully inspect the water ways, because small boats when old are very apt to be shaky about the water ways. The mast, spars, and sails must also be systematically overhauled. The gear should be looked to, and any old rope that exhibits the smallest symptom of chafe or decay replaced. It has been said that no Yachtsman ought to be seen below the Nore in anything under 20 tons. The best answer to such opinions is given in the cruises of the *Pet*, 8 tons, first round the Coast of England and Scotland, then to the Baltic and back, and the adventurous voyage of Mr. Middleton, in his little Yawl, *Kate*, 5 tons, in which he sailed alone, round England. These, however, are not the only instances in which Yachts under 10 tons have sailed hundreds of miles in perfect safety. The fact is, no matter how small the vessel, your cruising ground need not be restricted to the reaches of the Thames above the Nore. Much depends upon the qualities of the vessel herself. If you have a very shallow lightly ballasted Yacht, with an open cockpit, then by all means keep in smooth water, and under the lee of the land. If, on the contrary, you possess a fine

weatherly little craft, with ballast stowed low, and a heavy metal keel besides, and completely decked over, you need not scruple to adventure forth into the Channel in ordinary weather. It used to be considered absolutely necessary that a vessel to be a good sea boat must be very full in the bows and broad in the beam. Practical experience has taught us, however, that such craft are wet, uneasy, and leewardly. Indeed a modern racing 5-tonner would keep the sea and make good weather of it, when an old fashioned "London Hoy" would be obliged to run for shelter. I have often heard seamen who have been used to big ships all their lives, declare that a 30 feet ship's launch would ride out a gale, when a Yacht of 25 tons would be swamped. Considering, however, that the *Teazer*, 25 tons (not as large, by-the-bye, as a modern 20-tonner) went to the West Indies and back in 1852; the *Vivid*, 25 tons, made the voyage to Australia in 1864, and last, but not least, the *Pet*, in one of her voyages already referred to, weathered one of the heaviest gales ever known in the Channel; it is a pity that these self-opinionated gentry do not make themselves acquainted with such facts before putting forward such absurd statements. There is no reason in the world why a man with ordinary nerve and self-possession should not be as safe in a little craft of, say 5 tons to 8 tons, off the Land's End as he would be off Erith. Have we not the cruise of the *Leo*, under 3 tons, from the Thames to Penzance duly chronicled by her owner, Mr. McMullen, in his book "Down Channel" in 1857, and the Rev. Mr. Forwell's "Thousand Mile Voyage in the *Silver Cloud*," a half deck boat, 19 feet on the keel.

In buying a craft, choose one with a long easy bow, and good dead rise in floor. The flatter the floors and the bluffer the bow, the more uneasy a vessel is in a sea. The reason of this is easily understood by any one who has stood on the end of a long pier or jetty and watched the waves dashing against it. If the end is perpendicular and bluff, the water will fly upwards and over you, but if it is sharp or rakeing away, the water passes under it. Again, watch a Collier brig and a Yacht, anchored in a tide-way, with a strong breeze blowing. As the waves strike the brig, they rise up almost perpendicular, hitting her broad bows with a dull heavy thud, while against the sharp bows of the Yacht they divide, and scarcely seem to rise at all. With respect to a flat floor, it is detrimental to speed in a sea way, especially so when the vessel is small, because the momentum is insufficient to overcome the sudden stoppage caused by an advancing wave striking against the flat of the floor. This is what is meant by the Americans when they speak of a vessel as "spanking the sea."

The Amateur should begin his Yachting education in Erith Bay, or some similar sheltered water. A few days' sailing in a small Yacht up and down the Rands, with an experienced mentor in the shape of some elderly fisherman in attendance, will give any one really anxious to learn, considerable insight into the management of his little craft. After a week of such practice, the cruise may be extended as far as the

Nore, and from there into the Medway, and so on up to Chatham, taking care to have a correct chart of the river on board, and trust more to that than even the proffered advice of professed local knowledge. By-and-bye the Amateur may fancy a trip to Ramsgate, or Harwich, even a run to Boulogne and Havre may not seem a very hazardous undertaking. Before going very far from land, be sure you thoroughly understand how to handle your craft, under any circumstances of wind and weather. When once the Amateur is able to sail his little craft from Erith to the Nore and back single handed in a strong breeze, he may embark with confidence for longer voyages.

I have already spoken of the comparatively trifling expense of a small cruising Yacht, but a few details may be useful. First and foremost is the purchase of the boat.

Let us put that down for a 6 ton Yacht, with dinghy, at	£65	0	0
Recaulking, and the few repairs necessary to sails and gear	10	0	0
Expenses of a lad to look after her and keep her clean while afloat, at 15s. a-week for about six months of the year...	18	0	0
Sundries	5	0	0
Total expenses for the first year ...	£98	0	0

There are several means of lessening even the above expenditure. For instance, if the would be Corinthian is a bit of a mechanic, and has a little leisure time, he can find much amusement in doing the vessel up himself. Painting, varnishing and the various little odd jobs, which always have to be attended to about the interior of a newly bought craft, do not require any very great skill in their performance, but cost a good deal when done by regular workmen. Again, if the owner is living close to his moorings, he can dispense with the hire of a boy, and merely tip some waterman to give an eye to her occasionally.

A great deal has been written and said about the discomfort on board of small Yachts, but the same may be said of Volunteering, Deer stalking, Alpine climbing, and a dozen other sports and pastimes, indulged in by the youth of our tight little island. I have enjoyed myself on board a 4-tonner as heartily as if she had been 40 tons. True, we could not stand upright in the cabin, but when that little locality was entered, it was generally for the purpose of a rest. A couple of good cushioned lockers on each side of a table well furnished with eatables and drinkables, made us forget all about the smallness of our quarters. Then the sense of security one has, in knowing he can slip into some out of the way creek and lay there, clear of the track of passing steamers, is a comfort not enjoyed by those on board a larger Yacht. It is surprising how very snug and cosy the cabin of a little

5-tonner or 6-tonner can be made by a clever arrangement of the fittings. A nice little swing table, a neat locker on each side, made long and wide enough to form a sleeping berth, with an oil cloth for the floor (not carpet), and a couple of draw curtains to run along each side of the berths, are the principal things in the way of furniture. A good plan is to have the forward bulkhead fitted to fold back on each side, so that when there is no hand forward, those on board can have the benefit of a free passage of air fore and aft. The cooking stove, which should be as small and compact as possible, must be placed forward, and where it touches any wood work, well cased with iron sheeting, (zinc is apt to melt). A hammock should always be kept in the forecastle, it is useful, whether you take a lad to sea with you or not. A small zinc tank, able to hold five gallons or six gallons of fresh water may be fitted under the floor of the cock-pit, it will have to take the shape of the run of the vessel, and should be so fixed that it can be taken in and out easily. However, these are items which depend very much upon the form and construction of the boat. With regard to the rig for a small boat for cruising, I think the sliding gunter preferable to any other. The sail is easily handled, and by simply letting go the mast rope, sail is shortened to a close reef, and the earring can be passed and the points tied at leisure. The upper iron on the topmast should be made with a clamp, and the lower one should work on a hinge, so that by unclamping the upper iron, the topmast can be lowered right down on to the boom like a gaff, when stowing the sail. In Yachts, whether intended for cruising or racing, up to 100 tons the Cutter is the best rig. From 100 to 150 the Schooner, and after that the Brig rig. It has often been matter for wonder to me that the Brig rig has not been utilised for large cruising Yachts. In view of the acknowledged decrease in the species of the genuine British tar, it is to be regretted that some encouragement is not given to the rig amongst Yachtsmen. It would tend to emancipate owners from the monopoly exercised by the fishermen class of sailors, and form a real contingent for the Royal Navy in case of emergency. Neither is the rig itself without special recommendations, it is safer than a Schooner to scud with, because it avoids the nuisance and danger of gybing. The trimming of the square sails on board a Brig tends to make a long passage less monotonous, and the mast is easily accessible for a look out even in person if need be. Yachtsmen have pretty well exhausted their ingenuity in Cutters and Schooners, but is there not great scope for their inventive genius in modifications of the elegant little Brig with her stun-sail booms, her flying kites, and all the varied paraphernalia pertaining to her substantial bowsprit, her stout lower masts, and her system of manageable spars, which in point of fact gives her a compactness which imparts confidence in all weathers similar to that one feels on a large and powerful merchant ship.

Last, but not least, the expense of a crew for a Brig would not be above half that of a fore and aft Schooner of similar tonnage. For

instance, six able, and two ordinary seamen would be ample crew for a Brig of 200 tons, even for a voyage round the world, and I should like to see the sailing master of even the *Egeria*, to say nothing of the *Aline* or *Cetonia*, put to sea with less than dozen able seamen on deck. A rakish Brig Yacht would be rather a novelty, and if properly constructed, such a vessel ought to be able to make passages almost as quickly as the best of the Schooners. One of the greatest dangers to which the cruising Yachtsman is exposed, is being run down at night by Steamers. Those in charge of these last-named vessels are excessively careless, seldom having any look out forward. The fact is, there ought to be a rule compelling all Steamers to have a look out in fine weather on the heel of the bowsprit, and in bad weather on the foreyard. The present system of a look out on the bridge is bad. Often it is between two funnels, and when the enormous length of modern Steamers is considered, the look out amounts to nothing as to objects close by. Moreover, most of the Screw Steamers, cargo boats especially, have their engines placed aft, and this, when they are light, raises the bows out of the water like the side of a cliff, so that once underneath, the unfortunate crew of a Yacht or Smack can neither be seen nor heard. With respect to Steam Yachts, they are expensive toys, and I would warn young Yachtsmen against them. By taking a return ticket in a Cunard liner, he can have all the pleasures of a steam trip, at much less cost and anxiety than in a Steam Yacht of his own. I am aware that there are numerous Steam Yachts afloat and in commission, and no doubt there will be more, for alas! Steam is fast demoralizing the foreign going Yacht fleet, as it has already done our fleet of mercantile Sailing Clippers. An auxilliary Screw, it must be owned is a handy thing, but taking into consideration the dirt of coaling, the smell of the oil, expense for extra hands in the shape of engineers, &c., it is more bother than it is worth; besides, in a brig Yacht, a good launch with small portable engine could be carried on chocks between the two masts, easily hoisted out and in by yard arm tackles, and this would suffice to tow her clear of a crowded anchorage or through a calm; in fact, do all that was necessary in that way, without any of the drawbacks above mentioned. The best way of avoiding the chances of collision at night, is by keeping as much as possible out of the direct track of Steam vessels. In a small vessel this is easy, because from her shallow draught she can be kept nearer the shore while coasting along. Another very important precaution next to keeping a good look out, is always to have the lead line ready. It ought to be coiled up and hung in a becket in the main rigging (to the sheerpole); the end made fast, so that in case it got adrift from the becket, the line would not be lost overboard. It is extraordinary that the lead is so much neglected now-a-days, yet it is one of the best safeguards the Seaman can use.

It is laughable to witness the officer of the watch on board a fine vessel, sending a hand below to hunt for the lead line, to see what

depth of water they have got, *after the ship is aground!* On one occasion, getting benighted at the mouth of the Thames, I had to thread my way over the Flats from Margate to Southend entirely by the lead, and what little information we could pick up from some fishermen. There was no chart on board, so we had to feel our way with that old friend of the seaman, the lead, and of course made our passage in perfect safety. Never mind how bright the day, or how distinct are the land marks, put the lead over the side at once, directly there is any doubt whatever as to your nearness to a shoal. The first time I ever sailed from New York to Boston I had charge of a vessel, and although I knew nothing whatever of Long Island Sound, I managed to make the trip successfully, by feeling my way with the lead. It is something to be able to say, and I do so with pride, that I have never run a vessel aground. Some Yachtsmen of far greater experience than myself have often twitted me with over cautiousness, but if accidents are to be avoided, it is only by the exercise of a little timely care and attention. My advice to all young Yachtsmen, whether owners of large or small cruisers, is to keep a bright look out, and have your lead line handy.

CHAPTER XIV.

RACING YACHTS.

PROGRESS OF YACHT-BUILDING—INFLUENCES OF THE TONNAGE LAWS—SHIFTING BALLAST—CORINTHIAN MATCHES—THE YACHT RACING ASSOCIATION—THE RACER OF THE FUTURE.

YACHT racing, although not confined to the British Isles, is carried to greater perfection in the United Kingdom than in any other country. As observed in the last Chapter, it dates from the days of the Restoration. The example set by Royalty in pitting favourite pleasure sailing boats against each other, was quickly followed, and the exhilarating excitement attending a contest under canvas in a stiff breeze soon made it a favourite pastime of the courtiers, and sailing matches on the Thames were of frequent occurrence, long before a Yacht club was ever thought of.

Many persons suppose that the first racing Yachts were constructed on the cod's head and mackerel tail principle. This is erroneous, for we have reason to believe that the Dutch on their return voyages from the East Indies, brought over some Indian sailing boats, as presents

for Royalty and other great personages, and the great speed which these craft exhibited led to many copies. Indeed, I recollect seeing in an old collection of prints, published, if my memory is correct, about the beginning of the 18th century, a picture of a Thames passenger boat, then called a "tilt boat," from having an awning or tilt, spread over her amidships, instead of a cabin, and this vessel had very much the appearance of an Indian fishing boat. She had a long sharp bow, with the greatest beam apparently about two-fifths from aft. The regular cod's head and mackerel tail did not come into existence until near about the time of the first American war. Certain French privateers, committed great depredations upon our Commerce, and for a long time eluded capture, by reason of their superior speed. The English Admiralty thinking the long fine run which these vessels had, was the secret of their speed, built some revenue Cutters on similar lines, and this type of craft predominated for nearly half a century. There can be no doubt that some very fast vessels have been built on the short bow and long run principle. The secret of the success of this sort of craft, lies I think, in the fact that greater attention was paid to the form of the buttock lines than at a later period. In most treatises on Yacht building, the late Mr. Wanhill, of Poole, is credited with having originated the first great improvement in designing craft for racing purposes. As far as I have been able to discover, a native of the Sister Isle was the first to step out of the beaten groove with respect to the building of racing Yachts.

A Mr. Beamish, of Cork, as early as 1820 used lead for ballast, and in 1827 this same gentleman built a 27 ton Cutter, which had 4½ tons of lead ballast cast to fit in between the timbers. The Yachts constructed between the years 1840 and 1853 were great improvements upon their predecessors as racing vessels, because the advantages of extra length were becoming known. The length for tonnage being taken along the keel, it became the aim of the builder to keep this as short as possible, hence the great rake of sternpost seen in the lines of the *Volante, Thought, Mosquito, Titania,* and other Clippers of that era. In 1854 the Royal Thames Yacht Club following the example of the Royal Mersey Yacht Club, altered their mode of taking the length for tonnage, and measured Yachts on the deck instead of on the keel. This led to the owners of certain vessels, shortening their deck by bringing the sternpost in a few feet, and thus giving a longer counter, and then adding a bit on the keel. Some vessels were improved, others spoilt by such an alteration. Elbow sternposts were then tried, that is, the sternpost instead of coming up straight was thrown forward, above the water-line, at an angle, say of 45 degrees, and as the rule was to take the length from the fore side of stem to the aft side of sternpost, a foot or two was gained in length by such smart practice. A few sailing committees set their faces against this dodging, and made rules to prevent it, while others permitted it, so we had Yachts sailing in Regattas under different measurements, which caused much dissatisfaction.

Still the type of vessel which came into fashion under the old measurement rule still prevailed. With a few exceptions, the Yachts of that day were long, sharp, low in the water, the midship section very fine, and the greatest beam well abaft the centre; enormous spars and sails, quite out of proportion to the size of the hulls, were their distinguishing characteristics. They stood up to their canvas in a wonderful manner, owing to the practice of carrying some tons of shot in bags, which was shifted over to windward every tack by the crew. This system of trimming ballast prevailed more or less, although discountenanced by the majority of the Clubs as late as 1863, when, in consequence of the pressure brought to bear by certain influential Yachting men, it was rigidly put down by all the leading Clubs. Directly shifting ballast was done away with, many Yachts which had been considered Clippers, appeared to collapse all at once. To make them stand up without shifting ballast, extra weight had to be introduced, and consequently their trim being altered, their speed was destroyed. Others had to dock their spars and canvas and retire into the cruising fraternity. A few, the *Mosquito*, *Volante*, *Phantom*, *Thought*, *Vampire*, and old *Arrow* still held on and continued to win cups, but not to the same extent, because a new class of vessels sprang into existence. The difference between the Yachts of the past, and those of the present era, consists principally in the latter having a larger amount of freeboard, and consequently more spare buoyancy, and greater stability obtained by having a certain amount of lead on the keel. Lead floors and lead garboards are by no means unknown. With respect to the form of the vessels themselves, there is not very much difference. They are certainly longer, narrower, and deeper, but the general contour of the lines is much the same. I have mentioned the *Mosquito* as one of those Yachts which held her own, even after shifting ballast was put down. This craft, constructed in 1848, from the designs of the late Mr. Thomas Ditchburn and Mr. Waterman, was really more original in her chief characteristics than the celebrated *America*. In the "Illustrated News," of 1851, there was published an engraving of a vessel built for the Rajah of Lahore, in India, and the resemblance between her and the *America* was very striking. Many of the Arab Dhows are also not unlike that celebrated craft. The *Mosquito*, however, was quite an innovation among the English Yachts of the period, and her success at once induced many Yacht builders to copy her lines more or less.

The *Mosquito* has a long, sharp, hollow entrance, with the greatest beam well abaft the centre, and a comparison of her bow with that of the *America* shows many points of resemblance. After the advent of that Schooner, nothing was talked of but long bows. The cod's head was condemned off hand, Cutters and Schooners were hauled up on the building slips in every direction, to have a Yankee bow put on them. Exaggerated copies of the *America* issued from the yards of every boat-builder round our Coasts, most of which turned out utter failures,

because the true elements of the *America* design were unnoticed. A long fine bow, with a short fat run was supposed to be the principle of the *America's* success; whereas, the speed and weatherliness of the New York craft was owing to a carefully adjusted balance of the centres of effort, buoyancy, and lateral resistance, combined with the handsomest buttock lines I ever saw on a vessel.

Without wishing to detract from the undoubted merits of the *America*, I think it questionable whether she could have given the *Mosquito* her time in a race round the Island, and it is a pity they did not meet while the former had her American crew on board. The latter was a far faster vessel than the old *Aurora*, the second to the *America* in the cup race, and it is a fact, that the *Volante*, when she carried away her bowsprit, was picking up the *America*. Mr. Craigie, her then owner, accepted the challenge put forward by the Americans, but the latter wanted to sail without time allowance, and the sum $10,000 was so large that Mr. Craigie did not feel justified in competing against a vessel four times the size of the *Volante*, without at least a quarter of a minute per ton being granted.

I have referred to the fact that with few exceptions, Yachts of the present day are much the same in form as those of twenty years ago. Even that acquatic wonder, the *Jullanar*, is but an exaggerated *Kitten*, which was built by Messrs. Harvey & Co., of Wivenhoe, in 1852. The *Sea Belle* again, is only an elongated *Volante* (constructed by the same firm), the difference being that the former has a little more top side and a deeper keel. The *Miranda* Schooner has certainly more originality in her design, indeed, in the paper read by Mr. John Harvey, at the Institution of Naval Architects at the Spring Session of 1878, this is very clearly shown. In "Yacht and Boat Sailing," Mr. Dixon Kemp, in regard to this imitativeness, if I may so call it, upon the part of Yacht builders, tells us that it arises from the fact that Yacht builders, as a rule, "are too much occupied with the cares of their business to devote much time to the mathematical considerations of a design, and it is only their experience and a prudent purpose not to depart in any radical way from a model which practice has proved to be possessed of undeniable good qualities, that keep them from blundering into failure." No doubt this is the true reason why so much sameness is apparent among racing craft. Thanks, however, to the author of the above work; Yachtsmen who care to go into the intricacies of the mathematical problems of Naval Science, have now a point of departure to work from, as neither the late Mr. Marrett, or Lord Robert Montague, went far enough into the subject to make their books of much practical use to the would be designer. It is a pity that in "Yacht Designing" the lines of the *Neva* are not given, because she is said to differ materially from others of Mr. Fyfe's boats; if so, a description of these points of difference would be extremely interesting and useful.

The best schools for teaching the young Yachtsman how to manage

a vessel properly, are Corinthian matches. Success in Yacht racing depends so much upon coolness, self-reliance, and quickness of apprehension, that the constant participant in Corinthian matches, unless a very great lubber indeed, must of necessity imbibe some of these qualities. It may be as well to explain, for the benefit of the uninitiated, the meaning of the term "Corinthian match." A Corinthian Yacht match is a race sailed under a rule prohibiting the carrying of professional hands, all the crew, from the owner downwards, must be Amateurs. Some of the Clubs have so far relaxed these stringent regulations as to permit one, or it may be two, professionals on board, but they must not touch the helm during the progress of the match.

It is unfortunate that the 5 ton class, the most useful for beginners, has seemingly gone out of fashion on the Thames. In the Clyde and Dublin Bay 5-tonners are all the rage, and the manner in which they are handled during Corinthian matches, shows what a splendid nursery is this class of boats for young Yachtsmen. Should any of my readers be successful in obtaining a berth on board a competitor in a Corinthian race, the following hints may prove useful. First, as to clothing, which should be as simple as possible. Many Amateur sailors rig themselves out in a costume something between a cricketer and a T. P. Cooke's pirate. Others think a blue flannel Yachting suit the correct thing, but experienced hands content themselves with a fisherman's common guernsey frock, and pilot cloth trousers. This will be found by far the best suit for working in. A pair of canvas shoes with India-rubber soles must not be forgotten. For head covering a soft cloth cap, without peak, fitting tight to the head for ordinary weather, or a plain straw hat may be donned if the sun is extra powerful. Macintoshes are of little use on board a racing Yacht. A seaman's oilskin suit being far preferable. This suit, consisting of trousers, coat and Sou'-wester should be *oiled*, not painted, as the latter is apt to stain the sails or anything it may come into contact with. The best way on purchasing a suit is, to get some boiled linseed oil, then with a middling hard brush go carefully over the outside of each garment, rubbing the oil well in. Lay the oil on thinly, a little at a time. The art consists in rubbing it thoroughly into the grain of the cloth. When thoroughly dry, another coat may be added. A suit of oilskins treated properly in this manner, will be as soft as silk, waterproof, and last a long time. It is not a bad plan to have the seat of your working trousers covered with a piece of oiled cloth. This helps to keep one dry when the decks are wet. In the hurry and excitement of a race, there is no time to pick out a dry spot to sit on, besides the steersman may request you to sit further forward or aft, as the case may be. Oilskins are a sad incumbrance to activity, and are often pitched aside in the anxiety to perform some duty aloft smartly. The above device will therefore ensure at least one part of the person from suffering from a damp deck. Directly you get on board, ask the helmsman what he wants you to do, and when you are stationed at any particular rope, see

that it is all clear both below and aloft. Take the main halyards, for instance, and suppose you have to haul upon them directly the second gun fires. The timekeeper notifies the flying minutes between the two signals, and when he arrives at that breathless period when a few seconds only remain, don't get flurried, but stand ready for a steady hand over hand drag. I am speaking of a 5-tonner, where one hand is enough for the main halyards; in a larger Yacht, probably some older hand would be stationed with you, and then the novice cannot do better than attend to his instructions. Try and make yourself acquainted with the lead of every rope, and the proper place to belay them. I remember hearing rather a good yarn respecting the want of a little knowledge of this sort. A very smart youth, got up most extensively in parti-coloured flannels, presented himself on board a Yacht about to start for a Corinthian cup. On being asked if he was an entire novice, "Oh no! belong to an aquatic club, know all about it!" "All right, you stand by the main sheet." The gun fired, the canvas was set pretty smartly on the craft referred to, and she walked away with a good lead, the wind being nearly abeam. "Now then lads, in mainsheet," sung out the steersman, as the craft approached the point where they had to haul up to a close luff. Three or four clapped on to the hauling part, and sung out "all right, take off," meaning that our friend whose particular duty it was to attend to this, should take the end off the cleat preparatory to gathering in the slack ready to snatch a fresh turn. "What the —— is the matter, get that sheet aft can't you, angrily cried the helmsman," as two or three of the other Yachts came tearing round inside of the unlucky craft of our story. The main sheet men were seemingly hauling away like mad, but the boom was no nearer the quarter. On looking round, the mystery was explained. The Aquatic Club man had very sapiently cast off both parts, instead of only one, and but for the end having the usual knot in it, the main sheet would have been unrove. This was casting off the main sheet with a vengeance!

Another thing I wish to impress upon the young Yachtsman, don't lose your temper, or feel nettled because of a sharp word or two from the helmsman. In the excitement of the moment, very often things are said which are not strictly parliamentary, but due allowance should be made for the surrounding circumstances of the case. The position of the helmsman in a losing boat in a Corinthian match is certainly not an enviable one. If the boat wins, well and good, he gets deservedly praised, but should the contrary be the case he receives all the discredit of the defeat. It is useless to lay the blame on the crew; professionals understand well enough the disadvantages of a poor crew, but this is not the case with the general public, and therefore I say again, don't show any annoyance if your helmsman betrays any little ebulitions of temper, he will feel grateful for it when the race is over, and if he is a gentleman in feeling, will thank you, and esteem you besides.

Last, but not least, never be too proud or ashamed to ask the why

and wherefore of anything you don't exactly understand. It is a mistake to suppose that you excite contempt by so doing. On the contrary, a real Yacht sailor will appreciate you all the more, because he sees that you are anxious and willing to learn.

Every would be Yachtsman should strive hard to make himself a good helmsman. Steering is not a very difficult operation to learn, provided the pupil possesses ordinary intelligence, but to become an adept at steering a "fore and after" is not given to every one. Some authorities say that good helmsmen are born, not made, and certainly I have seen a novice in the art, display wonderful skill at the tiller, which can only be accounted for under the supposition, that it comes natural to certain people, like drawing, painting, &c. At the same time, a careful study of the effect of the wind on the sails, coupled with constant practice at the helm, will do wonders towards making a clever steersman. Another very important point in connection with racing is knowing the boat you are going to steer. The best Yacht skipper of the day placed on board a strange craft is all abroad for the first time he takes the tiller. It is surprising what a difference it makes in a vessel's sailing when there is some one at the helm who is used to the craft and knows her peculiarities. Such an one seems to judge instinctively whether she is doing her best or not, and by a little humouring, such as a pull on the jib-sheet, six inches more main sheet, or settling the throat halyards down a bit, achieves the most astonishing results.

One word more on this subject. When sailing a match, whether Corinthian or otherwise, never be tempted, no matter how exciting the contest may be, to infringe any of the sailing regulations. Rather risk the loss of the race than break one of the laws of the club you are racing under. That rules made by sailing committees, occasionally seem to bear more hardly upon some vessels than on others is a fact well known; but having once entered and started, the yachtsman becomes bound to adhere to the regulations however ridiculous they may appear. If you object to the rules put forward by any particular club, don't enter for a race under its colours; but having once done so, loyally obey them, even if the yachts are ordered to round the flagboat stern first.

For many years there was a general feeling among yachtsmen, that the different and conflicting laws and regulations under which matches were sailed, required amendment and codification. In 1863, a correspondent of the *Yachting Magazine*, under the *nom de plume* "*Red with White Maltese Cross*," proposed a set of sailing regulations which he suggested might be adopted by all the clubs, After some lengthened correspondence the subject seems to have dropped, but in the early part of 1868 it was revived again, and in 1869 a Yachting Congress was held under the auspices of the Royal Victoria Yacht Club, at which an attempt was made to bring about unanimity upon the part of the various clubs with respect to their sailing regulations. The code agreed to by this Congress did not, however, appear to meet with

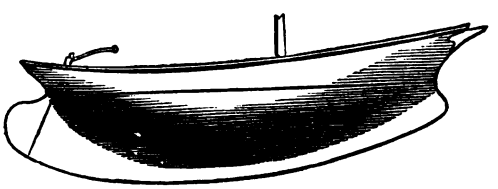
the approval of the yachting world, as the Congress received severe castigation from several well-known writers in the public press, notably from "*Red with White Maltese Cross*" himself. In 1874, owing to the "little unpleasantness" with respect to the alteration of the rule of measurement by the New Thames Yacht Club, it was determined once more to attempt the formation of a central committee of racing yachtsmen, which should deal with all questions affecting rules and regulations. During the latter part of 1875 the matter was finally settled and a society formed under the style and title of the Yacht Racing Association, which is intended to fulfil the same position in the yachting world as the Jockey Club does on the turf. One of the first steps taken by the association in question, was to adopt the rule of measurement known as the Royal Thames, with some trifling modifications, merely stipulating that yachts must be measured by the officials appointed by the council of the association.

Taking it altogether, the general opinion among racing yachtsmen is that the association has worked well, inasmuch as it has tended to make regatta committees more careful in the framing of their sailing regulations. Be this as it may, there is this to be said in favour of the Yacht Racing Association, that it has, by bringing yacht-owners together, produced more unanimity among the different clubs, and this must ultimately tend to the benefit of yacht racing as a sport. In 1867 a project was mooted to amalgamate the different Thames clubs, so that there should be only one gigantic yacht club on our metropolitan river, but the attempt was a failure for the reason that the Royal London and New Thames refused to sacrifice their independence for the doubtful advantages offered by the advocates of the scheme. Now, under the Yacht Racing Association laws, yacht clubs can still, to a certain extent, retain their own rules, or such of them as do not interfere with the spirit or letter of the Yacht Racing Association sailing rules. The Royal Yacht Squadron, however, has hitherto declined to adopt the Y. R. A. sailing rules, although last season this club relaxed its opposition so far as to permit "flying starts," that is, the vessels start under way across an imaginary line, instead of from anchor and with all sails down, as had been usual for years past.

The Royal Yacht Squadron has not been wanting in enterprise, however, for they followed in the wake of the Clyde (now the Royal Clyde Yacht Club) in trying the experiment of classing yachts by the area of their canvas in 1858. This idea was put forward by the late Mr. P R. Marrett, and was for some years used by the New York Yacht Club. It did not take, however, and in 1859 the Squadron passed a law taking the actual depth as a multiplier instead of half the beam. This was also dropped after a few matches were sailed under its auspices. In the following year (1860) the Royal Victoria gave a prize for decked vessels belonging to any Royal Yacht Club, not exceeding 60 feet *in length on or below the water line.* The *Cymba*, *Thought*, and *Glance* started. By this measurement the *Glance*, of

36 tons, had to allow *Cymba*, of 53 tons, 38 seconds. The latter won. This seems to have been the last attempt at interfering with the measurement until the Corinthian Club made the depth a factor in their tonnage calculation, which was followed by the New Thames in 1874, but the latter club, owing to the pressure brought to bear upon it by the other large clubs, abandoned the depth measurement and returned to the Royal Thames rule after a two years' trial of the new rule.

Notwithstanding all that has been written and said in favour of the present Yacht tonnage law, there is a feeling extant that it is not a satisfactory mode of classing Yachts for racing purposes. At the last session of the Institute of Naval Architects (1878), Mr. Dixon Kemp read a paper on the question, and suggested that a certain amount of the actual depth should be taken into consideration. This, however, has received almost as much opposition as the rule of the New Thames did when first put forward. It has done some good, however, in again calling attention to this much vexed question. At a meeting of the Y. R. A., held on the 6th June, (1878), it was resolved, on the motion of Mr. Baden Powell, to consider the alteration of the rule so far as regards taking the length on deck. This was done, and has resulted in the rule being altered from "the length from foreside of stem, to aft side of sternpost," to "the length on load water line," the rest of the rule remaining as before. Whether this alteration will be found effective in checking the tendency to "cheat tonnage" is doubtful. Unless the Yacht Racing Association insert the words *on* or *below* the load water line, some clever builders will be sure to evade it. Indeed it would not be surprising to find a craft come out something after the style of the sketch below. This type of vessel need not necessarily be a bad model. Her entrance and delivery could be as fine as any of the present craft, the only difference being that her lower water lines would be drawn out beyond her upper ones, thus increasing her size and power very materially. The fact is, no matter how carefully a tonnage rule is framed, an ingenious Yacht builder will find some plan whereby to evade its purposes. The only way of preventing anything of the sort would be to take the extreme length *over all*, in fact much the same as some Model Yacht Clubs do, by placing two uprights, and making the model pass between these posts. In a real vessel the distance between the two posts could be measured, and the length so found used in determining the tonnage. Those who are thinking of attempting anything in the Yacht building line after this fashion, must take care that they do not infringe Dr. J. Collis Browne's Patent, who has the exclusive right to produce, I believe, some such nondescript type of craft as the above.



CHAPTER XV.

OPEN BOATS AND THEIR MANAGEMENT.

THERE are no craft so dangerous in inexperienced hands as open boats, whether with or without sail. I have myself witnessed so many accidents occurring through the want of a little simple knowledge of the properties of these sort of craft, that a hint or two as to the right way of handling an open boat in a breeze and sea may prove useful. Youngsters, hardly in their teens, are every day to be seen during the summer months disporting themselves in some crank and dangerous looking skiff, and the wonder is that fatal accidents are not much more numerous. It would be a pity to deprive our British youth of the means of gratifying their taste for aquatics, but some discrimination ought certainly to be exercised by those letting out boats for hire to parties of youths, in seeing that one at least of the company knows how to manage an open boat. Very often I have seen a boat-load of young men and young girls in a state of extreme peril through carelessly allowing their craft to get under the bows of a vessel in stays, or through trying to cross close to the bow of a vessel at anchor

First with respect to the choice of a boat. The cockney youth out for a holiday with his sweetheart seems to have a peculiar liking for the most dangerous craft he can get hold of. I once remonstrated with a boatman who was letting craft for hire, for allowing two young men, evidently tyros in the art of boating, having with them a young lady, to go away in a thing little better than an outrigger. "Oh, sir, I can't help it, they would have that 'ere skiff, and what is one to do?" Fortunately the lady got so nervous at witnessing their bungling attempts to get the boat round in order to row up stream, that she insisted upon being put on shore, which was accomplished by running the boat stem on into the bank, pitching one of the men who had stood up to fend off with the oar into the mud.

Those who are not adepts in the art of handling a boat should choose a boat with plenty of beam and good bearings. Such boats are a little harder to row than the sharper and narrower skiffs, but then they are far less likely to capsize. If it is a tideway you are rowing on, keep as much as possible in the slack water near the shore. You are more out of the traffic and the boat will be more under command than if out in the strength of the tide; besides, the close proximity of *terra firma* may prove a blessing in case of an upset. Never stand up in an open boat. If you have occasion to change your seat, do so on hands and knees. If a steamer or sailing vessel is coming straight for you

and there is a doubt whether you can row clear, lay on your oars and shout. An experienced hand will back water, but a novice trying this will in nine cases out of ten come to grief, whereas it is the duty of steam and sailing vessels to keep clear of row boats, therefore if you remain stationary they will, if they see or hear you, alter their course accordingly. It is much wiser, however, not to attempt crossing a river or lake where there is any traffic until you have a tolerably clear spot.

Coolness and presence of mind are great requisites in the management of open boats. If there is a heavy following sea, such as sometimes gets up on the Southern coast very suddenly, don't get frightened and begin tugging away at the oars as if for dear life until exhausted and nerveless; you lose control of the boat which may then broach-to and swamp. It is a great mistake to think that the only way to avoid being overwhelmed by a following sea is to go at great speed through the water. On the contrary, the easier a boat is rowed under such circumstances the better. I learnt this while at Table Bay, Cape of Good Hope. The ship I belonged to was lying about three miles off the town waiting for sailing orders. The captain had allowed the crew a day's liberty on shore in watches of four men each, and on the day our sailing orders arrived, it became my duty to take the last four men on shore in the gig, then return to the ship until 9 p.m., when I was to fetch the captain on board; the Cutter, which had gone ashore for water, having orders to bring the men off at 8 p.m. At supper time as it is called on board ship, tea time on shore, the breeze began to freshen up and the clouds above Table Mountain to settle down on it until "the cloth was laid," the clouds at such times having the appearance of a huge pall over the flat table-top of the mountain. There were only the chief officer and myself on board besides the cook and eight hands. Six were away in the cutter with the second mate, and four on shore on leave. The third mate, boatswain, and carpenter were also on shore on leave. I being only a youngster, the mate did not half like my taking charge of the gig, but he could not leave the ship as there was every prospect of a blow before nightfall, and a gale in Table Bay is not a very desirable thing, even with two anchors down. So at 7.30 he ordered me to take two hands and lower away the gig. She was a beautiful boat 20 feet long and 4 feet 6 inches beam, and generally rowed four oars. The captain was particularly careful of her and knowing that I was a bit of an enthusiast in the matter of yachts, boats, etc., placed her under my charge. She was clinch built, bright varnished, and had quite a yacht-like entrance and delivery. The tide was not running out very strongly, it was within about an hour of low water, and we soon pulled ashore; and while the men waited at the steps I walked up to "The Captains' Rooms," a sort of club like the "Jerusalem" in the City, to see if I could see our skipper. He had, it appears, left some time since, so I thought it best to get back to the boat, and found her lying about three tiers off

amongst a lot of other craft, with a nigger boy in charge. On asking him what he was doing there he said. "De men belonging to de boat give me one quarter dollar to stay till dey come." "Oh," thinks I, "here's a pretty mess. The skipper will be in a nice temper when he finds the boat with no one in it." However, I was not going to lose my men, so set off to the nearest liquor bar, judging that they would not go far. As I expected, they were soon found, but, and to this day I can't think how they managed it, considering that they could not have been away from the boat more than half-an-hour, both just about as drunk as they could be without falling down. To get them down to the boat was a work of no little difficulty; persuasion and coaxing had little effect, threats were useless. However, I did get them down at last, to find the captain on the steps with the steward and the four liberty men, the latter in a far worse condition than my own crew. "Where is Mr. M —— and the cutter?" asked the captain, sternly. "I don't know, Sir," was the reply as I touched my cap. "What time did you come on shore?" "At 8 o'clock, Sir." And then I explained that the mate thought it best for the gig to come on shore before the weather got worse. It was now blowing a regular sneezer right into the Bay. "Perhaps, Sir," ventured I, "Mr. M———, having such a heavy cargo and seeing the rising gale, thought it best to get on board." This idea was seconded by the steward, and then the captain, turning to some men waiting on the quay with a bullock truck said, "Tumble that live stock and the other things into the boat, sink or swim she shall go off to the ship to-night." Three sheep, two pigs, two baskets of fowls and ducks, three cases of wine, and four barrels of bottled beer were shoved into the boat, the drunken crew trying to assist, in which operation two of them fell into the water and were rescued much sobered by their immersion. In getting out, the heavy swell setting in, ground our stern against the steps, and broke the upper pintle of the rudder. Fortunately there was about 1½ inches of it left, so that by keeping one hand on the rudder to prevent its jumping out, it was possible to steer. Pulling four oars, the boat loaded down nearly to the sheer strake, at last got out from the shelter of the piers and felt the full force of the sea. Every wave seemed as if it would come on board us. The quick, stern commands of the captain were well obeyed, however, the men appearing to be sobered by the danger. I had the full benefit of the situation, sitting as I was right at the stern, with one hand and half my arm under water keeping the rudder from unshipping, and I could not but admire the skilful manner in which the captain managed the boat. Every now and then, without turning his head, he would cry out "Easy all," as a gigantic wave would come roaring and thundering up astern, and then as it lifted our boat up in the froth as if it had been a feather, the order came "Give way, men, with a will," and we shot down into a valley of dark seething water and were climbing the next wave, when "Easy all; back water, men, for your lives," and I held my breath

as I saw the enormous mountain of water, in comparison with our little boat, heaping up astern of us, but it passed like others. I remember we passed a barque dragging her anchors, and they shouted something to us, but the sound was borne away to leeward and we dared not deviate an inch from our course. An hour and a half brought us within hail of our own good ship, riding with 75 fathoms of chain on both anchors. She was 700 register tons, but she was pitching her hawse pipes under water, which will give some idea of the sea that was running. We could not get alongside in the ordinary way, but steered so as to bring the boat clean under the bows, and trusted to those on board being ready with a line. Directly the line was in the boat it was made fast to the ringbolt in the bow, and the boat veered right astern. She was then hauled cautiously up under the counter, the stern ladder was lowered, and each man watching his opportunity sprang on to it. Myself and one hand were left in the boat to hook on the tackles, which we successfully accomplished by eight bells, *id est*, midnight; all hands except the anchor watch were snug in their berths, the gig's crew none the worse for their three miles' pull. The second and third officers, with the cutter, had been on board some hours.

Thus I learnt the value of knowing how to manage a boat in a heavy sea. I noticed that the boat was eased, and sometimes backed, into the head of the advancing waves, and then rowed along with the sea that had just passed under her, until the next began to overtake her when "easy all." was the word again.

Rowing against a head sea is a much easier operation Care must be taken to keep the boat steady, and not yaw her about, so that she catches the sea on the beam. Another important point is having a good baler on board. If you are going anywhere were the water is likely to be very rough, a bucket is the best thing to take, the small tin balers are only useful for river work. With respect to the fitting of an open boat for sailing purposes, the first consideration is the ballast. I do not believe in sand bags, breakers of water, and other loose stuff for ballast. The boat should have either a lead or iron keel, and the inside ballast should be metal pigs securely fastened to the bottom between the limbers.

Again, an open sailing boat should be constructed so that she will float, even if full of water, with all her ballast, stores, &c. on board. This is easily done. The fore part should be made water-tight, with a zinc or copper casing inside, so that if the wood work warped or cracked no leakage could occur. The stern sheets ought also to have zinc compartments, and the sides as well. It is astonishing what a weight a few water-tight tubular cases of zinc or copper will sustain, and it has often surprised me that more use is not made of so simple a contrivance. About £3 will fit a boat 20 feet long, having 6 cwt. of ballast, with air-tight casing sufficient to keep her afloat when waterlogged. An open boat of this length, with 6 feet beam, ought not to

want more than the above weight of ballast, namely, 3 cwt. on keel, and 3 cwt. inside, or the whole may be placed on the keel.

A good rig for this sort of craft is a sprit mainsail, and small foresail spread on an iron bumpkin projecting about 1 foot 6 inches outboard. No boom to the mainsail which should be well peaked up. A couple of brails round the sail are very handy, This is generally the rig of a Thames wherry. Portsmouth and Isle of Wight wherries sometimes carry in addition a small sprit mizen. On the East coast the favourite rig for open boats is the lugger rig. Yarmouth beach yawls, as they are styled, carry three lugs and a jib set on rather a long bowsprit. These craft are very fast off the wind and on a reach. They sometimes exceed 60 feet in length. The reader has doubtless heard of the famous Deal luggers. These boats are more powerful craft than the Yarmouth luggers. They carry two lugs and a jib, although I have seen them occasionally with a third one. They are manned by a hardy race of men who do not hesitate to face a breeze, whether it is in the hope of gain in the shape of salvage, or to rescue the crew of a foundering vessel. I was much struck by the extraordinary smartness exhibited by a deal lugger in stays. It seemed that no sooner was her helm down, than she was full on the other tack. The mystery was explained to me by one of her crew whom I met afterwards. He said "You see, Sir, in winter time, and when it blows hard, we has two fore lugs, double halyards, and tacks and sheets, and instead of dipping to leeward of the mast every time we goes about, we down helm and let's go the fore lug halyards at the same time, while half a dozen of us tail on to t'other halyard and up goes t'other one, sheet and tack all fast, so that its nothing but a good pull, a strong pull, and a pull altogether." "You don't even have to touch tack or sheet then?" questioned I. "No, Sir, we doesn't, all of us chaps being right in the body of the boat you sees, Sir, we leads the halyards under a snatch block, so that we walks him right aft without any trouble." I should explain that the fore lug is what is called a "standing lug," that is the tack is fast to the stem-head with nearly a third of the sail before the mast. It is, therefore, necessary to have the yard to leeward of the mast in beating to windward, or else the sail would not stand properly. This is accomplished by "dipping the lug," that is lowering the sail half down, shifting the tack round the mast, at the same time hauling down on the luff until the fore part of the yard is up and down the mast, when it slips to leeward, and the sail is re-set. The French fishermen sometimes lower the sail right down, unhook the halyards from the yard, and pass the sail the other side of the mast; this is a very lubberly way of "dipping a lug."

In sailing in an open boat steer with a tiller, *not* yoke lines. Take a half-turn with the foresheet and hold the end in your hand ready to let go in an instant. If it is squally the mainsheet must also be held in the hand with a half-turn on the cleat. The foresheets should lead right aft one on each side, through eyebolts inside the gunwale of the

boat. I have often when sailing in an open boat, managed to let go both main and foresheets at the same time, by having the foresheet bent on to the mainsheet, so that when the latter was hauled taut it also hauled the foresheet taut, and on letting go the mainsheet the foresail fluttered in the wind. Sit low in the boat and directly you see the gunwale nearing the water luff her up to it; never sail an open boat as if she were decked; remember that directly the leeside is level with the water, under she must go. Again, always take care that the foot of the sails is cut very high. This is a great safeguard, as a sea striking a boat on the weather side generally flies over into the mainsail, and if the sail is low down in the boat, a whole avalanche of water comes pouring into her; but if the sail is cut high up, the greater part of the water passes over the boat clear away to leeward. I have noticed this several times, and I see it is mentioned in *Hunt's Yachting Magazine* for September, 1878, in a yarn headed "My Salt Water Baptism."

I must not close this chapter without a reference to Milford Yawls as they are called. Little bits of craft, but powerful for their size, some of them not more than 13 to 15 feet in length, and rigged with mainsail and foresail. They are 5 to 6 feet beam and about 2 feet 6 inches deep, keel about 6 inches deep. They are handy boats and are seen knocking about the Bristol Channel in all weathers.

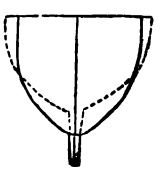
In a very shallow boat the keel should be deeper than in a boat with a good draught of water, A boat twenty feet long should draw at least 3 feet aft and 2 feet forward. There are many varieties of open boats, such as Cobles, North Country fishing boats, etc., but those I have described are about the safest and best. Always remember to *see there is a good cork plug in the* boat's bottom before venturing afloat.

CHAPTER XVI.

THE DESIGN FOR A RACING YACHT.

THERE are many persons connected with Yachting who view attempts at Amateur Designing with disfavour, though why this should be, I am at a loss to conceive. Considering the number of fast vessels that have been launched, the lines of which have been draughted by non-professionals, it does seem strange that so little encouragement is given to those who try to emulate the success of the late Squire Weld, and that practical Irish Yachtsman, Mr. Caulfield Beamish. However, there is no doubt but that the number of Amateurs who have failed to produce a crack racer, is greatly in excess of those who have succeeded in designing craft able to compete successfully with vessels built by regular Yacht builders.

I ascribe a portion of the said failures to the operation of the tonnage laws. Amateur Designers, who really think they have discovered something good in the way of Yacht architecture, too often fail to perceive that a vessel constructed upon the lines they believe in, must to a certain extent be handicapped, when sailing against vessels built expressly for racing under a certain rule of measurement. I am not going to deliver any opinion as to whether the rule itself is faulty or not, but there can be no question but that the way the tonnage of Yachts is calculated, has tended to favour the building of one particular type of vessel, to the exclusion of other forms. I do not agree with those who, in their arguments against the Royal Thames Rule of measurement, affirm that it has produced a bad type of vessel. Indeed, a comparison between our Yachts, and those of America, show that for seaworthiness and handiness, the advantage rests with us. At the same time, the genius of Naval Architects has, to some extent, been trammelled by the rule of measurement, and although I for one should be sorry to see our magnificent pleasure fleet changed into an Armada of skimming dishes, only useful in smooth water and summer breezes, still a rule of measurement which would more correctly represent the exact size of a Yacht would be an improvement. The opponents of the present rule argue, that inasmuch as the depth is not measured at all, but is assumed to be half the beam, a broad shallow boat is handicapped by being made to appear larger than she really is. That there is a great deal of reason in this argument no one can deny; for instance, take the sections in the cut to represent the form of two vessels of equal length, and of exactly similar size. Measured however by the Royal Thames Rule, the vessel represented by the dotted section would measure considerably more than the other, because, although the amount of beam to be deducted from the length would be greater, it would not make up for the extra beam, which would be used as the first and second multiplier in calculating the tonnage. This will be understood better by an explanation of the rule now used to measure the tonnage of Yachts. "The length is taken from the foreside of the stem, to the aft side of sternpost on deck (now altered to the water line). From this deduct the breadth, the remainder shall be deemed the true length to find the tonnage. Multiply the length so found by the extreme beam, and the product by *half the beam*, and divide the whole by 94, the quotient shall be deemed the true tonnage."



Now it is obvious that the wider of the two vessels represented by the sections given above, must come out as already stated, and that in no slight degree, larger than the narrower but deeper craft. Even supposing the wider vessel were reduced still more in depth it would not make any difference to the measurement, and the narrow one could be increased in depth *ad infinitum* with the same result.

The importance of depth in a racing Yacht is very great indeed, and

I question whether the limit has yet been reached. In 1871 I ventured to question, in the *Field*, under the signature of "Hold to Windward," the wisdom of building a vessel like the *Livonia* to compete with the *Sappho*, on the ground that the latter was longer, much broader, and *as deep* as the former, and I asked the reason why a vessel the size of the *Cambria* could not be constructed with the same proportions of depth to beam as the *Mosquito?* This excited the ire of a correspondent of the same journal who, writing from Boston, United States, under the *nom de plume* of "British Yachtsman," ridiculed the idea of any Yacht drawing 16 or 17 feet of water. Since then, within the short space of 10 years we have a fleet of racing vessels of 80 to 150 tons, drawing on an average from 13 to 15 feet of water. Those who argued against depth also alleged that a vessel with a greater depth of water than 11 or 12 feet would require an enormous amount of canvas to drive her, because the water increases in density at a given ratio for every foot of depth beyond the first five or six feet. The author of "Yacht Designing" thinks differently, and quotes as an authority Mr. Froud, the scientific adviser of the Admiralty, who says, in reference to a series of experiments tried at the instance of the Constructive Department, "*that relative depth of immersion has little or nothing to do with the resistance of bodies moving in fluids.*" I myself have always thought that the influence the increased density of the water may have on the speed of a very deep vessel must be very slight indeed. There are, of course, other considerations which tend to limit the depth of our large Yachts, one of the principal being the shallowness of some of the harbours round the coasts of the United Kingdom. Those who have had to "lay to" outside a port on a wild blowing night, in consequence of the vessel drawing too much water to risk a passage over the bar in the dark, can appreciate the comfort of having a craft able to hop in and out of harbour at almost any time of tide. In a 10, 20, or even a 40-ton Yacht an extra foot or two of depth does not so much matter, as there are few places where a vessel, drawing under 12 feet, cannot find a berth. In large Yachts it is different, because directly the draught of water exceeds 14 or 15 feet, then the vessel is debarred from the privileges which have much to do with making Yacht-sailing so delightful a pastime.

In building a vessel, however, for the special purpose of bringing back the cup won by the *America* in 1851, everything should be sacrificed, I think, to the one object, and if it were thought that a couple of feet extra depth would place a Yacht of 23 feet beam on an equality, as regards power, with one of 27 feet beam, she ought certainly to have it.

With respect to the design for a racing Yacht, Plate 6, there are several important *desiderata* kept in view. She is intended to be a compromise. She has good beam being 8 feet 6 inches at her widest part. Her draught of water is not excessive, (6 feet), while her extremely small area of wetted surface, in proportion to her carrying

power, would insure speed. Although a good boat off the wind, her best points would be brought out in a dead beat to windward, while in strong breezes and heavy sea her extra length above water would come into play. That this extra length is a benefit is proved by *Buttercup*, and unless another change is made in the measurement rule raking stems will again come into fashion. After all a plumb stem is only a comparatively modern innovation. When first introduced it was pronounced "very ugly," as it made the then boats look "snubby." At present it is considered by most people essential to yacht beauty in a cutter, but "handsome is that handsome does." The same design would do for a 5 tonner.

It will be noticed that the mid-ship section is different from the mid-ship section of most modern racers, which have concave or hollow sections, the bilge and keel resembling the letter S. In the design *Plate* 6, however, I have carried the floor up in a straight line from the garboard strake to the turn of the bilge. From numbers of experiments I am convinced that a straight mid-ship section is superior to a hollow one, and that my conclusions are based on sound data is seen by a reference to "Yacht Designing." In that admirable work Mr. Kemp says: "A plane surface for the keel and deadwood offers much greater resistance to lateral pressure than curved surfaces with, *if the curve be concave*, the advantage of less area"—the italics are my own. Further, the same authority observes in reference to straight mid-ship sections, that they, "Whilst increasing the ardency of the lateral resistance will add a little to the stability," and after proving the truth of his argument by an explanatory diagram, winds up by saying: "Thus a square garboard is more effective for lateral resistance than a curved one."

With regard to the question of hollow *v.* straight sections, an opinion on the subject from an old Barking fisherman may not to some persons seem worth very much, but taken in connexion, however, with what I have already quoted, it ought to have a certain weight. The opinion of the man in question was this: "The straight-bottomed Barking smacks always beat the hollow ones going to windward when it blows hard."

In designing a model for racing purposes regard must be had to the particular rule of measurement under which she is to sail. The Model Yacht Sailing Association measures the length between the perpendiculars, allowing a counter, which must not exceed 2½ inches in 2 feet class and 3 inches in 2 feet 6 inches class. First-class boats must not exceed 2 feet 6 inches. It is a rule, also, that first-class boats must have more than one mast. I have therefore thought it best to publish the design for a 2 ft. 6 in. yawl, between perpendiculars, that appearing to be the favourite rig in the Club for the first-class boats. The dimensions are as follows:—

Length between perpendiculars ...	2 feet 6 inches.
Do. over all	2 „ 9 „

CHAPTER [illegible]

THE BALANCED LUG [illegible] OTHER RIGS.

SUCH a stimulus has been given [illegible] Building and Sailing since the first edition of this [illegible] more difficult than [illegible] building, but the sailing [illegible] a science. Perhaps [illegible] differ so widely as [illegible] over other rigs. [illegible] an advantage. [illegible] mast being stepped [illegible] important *desideratum* [illegible] A great deal, however, depends [illegible] For instance, a long, narrow craft with great dead rise [illegible] not answer so well under the lug as she would rigged as a [illegible] The form that is best adapted for the balanced lug is a boat with moderate beam, a very full midship section, little or no dead rise, and fine ends.

The favourite rig for this kind of model is the balanced lug and lateen mizen. The annexed sketch will give a better idea of the style

FIG. 1.

Breadth, extreme	...	...	...			8 inches.
Depth aft	...	...	...	...		$6\frac{3}{4}$ „
„ forward	...	...	...	...		6 „
„ keel amidships	...	...	...			$2\frac{1}{2}$ „
Thickness of keel		...	...	...		$\frac{3}{4}$ „
Weight of keel	...	...	...	...	8 lbs.	4 ozs.
Spars.—Mainmast		...	...	...	2 feet	6 inches.
Mainboom		...	...	...	2 „	1 „
Gaff	...	...	...	...		17 „
Topmast		...	...	...		18 „
Topsail yard	...	...	...			20 „
Bowsprit outboard		...	...			16 „
Mizen mast	...	...	...			14 „
„ yard	...	...	...			12 „
„ boom	...	...	...			14 „

Sails to be made of best Horrockses' long cloth, hand sewn and taped round the cross-cuts.

The other design is for a 3 feet cutter to sail under the Victoria Park Club rules. They allow a counter, also over and above that measurement. The dimensions of this boat are :—

Length on load water line		...	..	3 feet.		
Beam	...	...	...	...	...	10 inches.
Depth forward	...	...	...	...	6	„
„ aft	...	...	...	...	8	„
„ of keel deepest part		...	...	3	„	
Thickness of keel		...	...	...	1	„
Weight „		...	...	...	16 lbs.	7 ozs.
Spars.—Mast	...	...	...	...	3 feet.	
Bowsprit outboard		...	...	1 „	8 inches.	
Mainboom		...	...	...	2 „	7 „
Gaff	...	...	...	...	1 „	8 „
Topmast		...	...	...	2 „	
Balloon topsail yard		...	...	3 „		
Working „	„	...	...	18 inches.		

This boat would take about 10 ozs. more lead inside, but the exact place to put it can only be found by experiment under sail. Place it first in the body of her, as A in the diagram, and then shift it a little forward or aft and you will soon get her right trim. Sails made of best stout long cloth and taped round the cross-cut edges.

CHAPTER XVII.

THE BALANCED LUG *v.* OTHER RIGS.

Such a stimulus has been given to Model Yacht Building and Sailing since the first edition of this Work was issued, that a beginner finds it more difficult than ever to compete with older hands. Not only the building, but the sailing, of Model Yachts has now virtually become a science. Perhaps there is no point upon which Model Yachtsmen differ so widely as in the question of the superiority of the balanced lug over other rigs. For certain purposes the balanced lug has undoubtedly an advantage. The driving power is more concentrated, and from the mast being stepped so far forward less head sail is required, a most important *desideratum* when sailing close hauled in a strong breeze. A great deal, however, depends upon the form of the Model itself. For instance, a long, narrow craft with great dead rise in floor, will not answer so well under the lug as she would rigged as a Cutter. The form that is best adapted for the balanced lug, is a boat with moderate beam, a very full midship section, little or no dead rise, and fine ends.

The favourite rig for this kind of model is the balanced lug and lateen mizen. The annexed sketch will give a better idea of the style

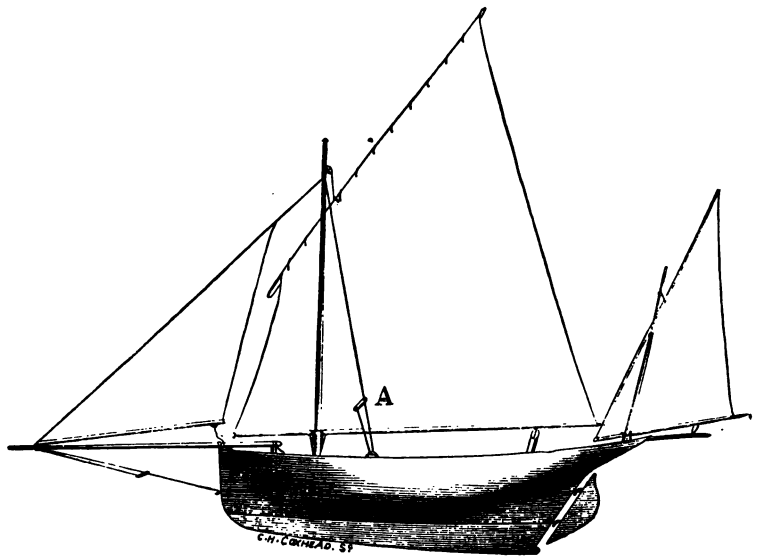


Fig. 1.

of boat referred to. The keel should be deep, especially aft; for a 2 feet model say not less than 2 inches, and so on in proportion. The tack of the lug is hooked to an eyebolt in the mast, and the yard hooked on to a traveller, to which the halliards are attached, which are then brought down and hooked to an eyebolt screwed into the gunwale just abaft the mast on the port side, while the jib halliards lead to an eye on the opposite side, so that when they are set up, by means of the toggle, see A, Fig. 1. they form shrouds for the mast. The mizen yard runs almost parallel with the mast, the lower arm being hooked into an eye on the boom and the tack hooked to the mast, as in the sketch. The mizen sheet leads from the boom through an eye in the bumkin, and is pinned to a piece of wood screwed to the deck, with holes bored in it, see Fig. 2. Some Model Yachtsmen have the same plan for

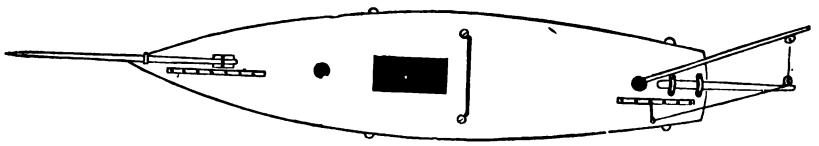


FIG. 2.

working the jib sheet, shown in the same Cut. A supplementary sheet, shorter than the ordinary sheet, is used for guying, that is, keeping the mizen boom from shifting when the boat is put on the other tack. This ensures the boat tacking again before she has gone very far—most important when only a short tack is required to fetch the goal or turning point.

The advantages claimed for this sort of rig are, first, its simplicity, second, the undoubted speed it gives a boat when sailing free, and thirdly, that a boat under a balanced lug will sail closer to the wind than under a gaff sail. With respect to the simplicity of the balanced lug rig, it is true only two halliards are required, namely, the main and jib halliards. Reefing a balanced lug is considered to spoil the set of the sail, although this also applies to a gaff sail, the fact being that if the cloth out of which the sail is cut has been properly stretched in accordance with the instructions already given, reefing has no business to pull the sail out of shape. It is the fashion, however, to have three, or even four, lugs; from the big one for light winds down to the storm lug, and as the jib must be shifted at the same time, an equal number of the latter must be on hand, so that there is not much saving as regards the bundle of sails, spars, etc., carried about. Again, the long yard of the larger lugs is a serious inconvenience. When the boat is packed up for transport, the yard projects beyond the parcel, unless made in joints like a fishing rod (a serious increase of weight by-the-bye). Projecting spars are always getting broken, so a case has been invented by some Model Yachtsmen, a sort of quiver, in which the spare sails and spars are stowed. A couple of small mizens are also requisite for strong winds, to balance the shift of jibs.

That the rig is an admirable one for beam wind sailing cannot be gainsaid, but unless the breeze is steady and true in force, the balanced lug will cause a boat to play some awkward tricks when least expected. In moderate puffy winds, verging to light zephyrs, it is far inferior to the legitimate Cutter or Yawl, or even the Schooner. With respect to its close-winded properties, the balanced lug on the lee tack, that is, the tack when the yard and boom are on the lee side of the mast, sets very flat and makes a model sail very near the wind; on the other tack, however, she requires careful management; if the sail is not trimmed to a nicety, she will be either all up in the wind, in irons in fact, or falling broad off, will be making nearly a reach of it, while the more certain Cutter goes pegging steadily away to windward.

On those waters like the Round Pond, Kensington Gardens, where the prevailing winds are three-quarter ones, that is from one corner to the other, see Fig. 3, the arrows showing the directions of the wind, the dotted line the course, the balanced lug answers very well, for there is hardly any cross tacking, and the sail can be set so that on the long board the model has the yard and boom to leeward of the mast. In running dead before the wind, the balanced lug forms a powerful sail, but a very large and heavy rudder is required to keep a boat rigged in this style steady when the wind is strong. If the breeze is at all puffy or squally, boats rigged in this way do not keep their course so well as a Cutter does when scudding. To sum up, the rig will be found useful to experimentalize with, and under certain circumstances as good, if not better, than either the Cutter, Yawl, or Schooner.

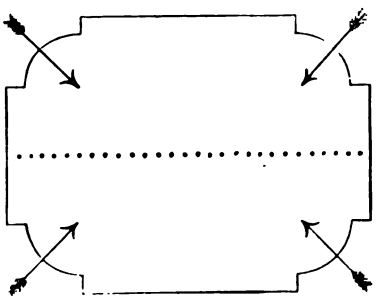


Fig. 3.

CHAPTER XVIII.

MODEL YACHT CLUBS AND RULES FOR SAILING.

During the last few years Model Yacht Racing has become quite a recognised sport, and the accounts of miniature regattas find a place in the Sporting Journals side by side with the records of the doings of real Yachts.

At present there are something like half a dozen Clubs in the Metropolis alone, the principal being the Victoria Park Model Yacht Club, established in 1862; the Serpentine Model Yacht Club, established 1873; the Clapham Model Yacht Club, which first came into notice in 1872, and the Model Yacht Sailing Association, whose headquarters are the Round Pond Kensington Gardens, established 1876.

Each of these Clubs has a slightly different system of measurement, although the Serpentine Model Yacht Club is the only one in London which has adopted the Y. R. A. rule, taking one inch to represent a foot in calculating the tonnage. For the benefit of those of our readers who may wish to join either of these Clubs I subjoin the Secretaries' names and addresses, with an assurance that any intending competitor in their matches will meet with a hearty welcome; fair play and no favour being the motto of the Model Yachtsman. As a guide to those intending to form new clubs the following summary of Rules, based on those of several existing Clubs, will be found useful.

Rules of the "——— Model Yacht Club."

I. That the Club shall be called the Club.

II. That the members shall meet once a month, when the chair shall be taken by one of the officers present.

III. That five members (including at least one officer of the club) shall be sufficient to form a quorum.

IV. That the election of officers shall be annual, and the accounts audited half-yearly.

V. That the annual subscriptions shall be — payable in advance; and for honorary members — payable in advance, with an admission fee of — for each member.

VI. That whosoever shall suffer his subscriptions or fines to be in arrear shall forfeit his privilege of voting until they are paid, and after six successive months of default he shall be considered no longer a member.

VII. That no person can be a member until he has been proposed at one monthly meeting and balloted for on the next; one dissentient in three to exclude.

VIII. That the members may each introduce a friend at the clubroom.

IX. That no member shall lend, sell or give away the club colours, nor shall he permit any yacht besides those he has registered in the club books to carry them.

X. That a silver cup, or something equivalent in value, shall be sailed for at least once a month.

XI. That the wilful infraction of these rules, or the sailing regulations, shall subject the member or members to expulsion.

SAILING REGULATIONS.

I. That no member whose election has been within one month, or whose yacht has not been registered and named at least one month previous to the day for the match, or whose subscriptions or fines are in arrear, shall be eligible for the ensuing match.

II. All yachts entered for club matches must be sailed by their owners only.

III. That all yachts entered for a club prize shall be propelled by wind and sail only.

IV. That every yacht shall carry a distinguishing colour of a size agreed upon.

V. That no member shall be allowed to enter more than one yacht in the same match.

VI. On the day appointed for a match the Officer of the day shall mark out the stations and boundaries, and see that the sailing members have notice to take each one his proper position. Stations to be drawn for on the morning of the race.

VII. That no member, under any pretence whatever, shall touch any yacht engaged in the match after it has taken its station (except his own) until the prize is won.

VII. That when the wind is such as to necesitate beating to windward and running, a yacht must be put fairly about when close hauled, and jibed when before the wind on touching the shore, no polling by means of sticks allowed.

IX. That wilful obstruction on the part of any one member towards another during the match shall subject the offender to a fine or expulsion, as the club may decide.

X. That the prize shall be presented to the winner by the chairman at the first monthly meeting after the match.

XI That as many unforseen circumstances may render it necessary to rescind one or more of the foregoing rules, it shall be in the power of the competing members to call a general meeting for that purpose, when the arrangements made shall be absolute for the forthcoming match only.

The measurement rules have been left out purposely, but the best rule is an over all measurement, allowing a counter, at the rate of an inch to a foot,—thus a 3 feet boat would have a counter 3 inches long.

SECRETARIES' NAMES AND ADDRESSES.

Serpentine Model Yacht Club —Mr. E Hodges, 31, Devonshire Street, W.

Model Yacht Sailing Association. Station, Round Pond, Kensington Gardens, London, W.—Mr. T. Harvey, High Street, Kensington, S.W.

Victoria Model Yacht Club. Station, Victoria Park.—Mr. W. H. Melvill, 9, Frederick Place, Bow, E.

Alexandra Model Yacht Club.—Victoria Park, London.

Clapham Model Yacht Club. Station, Long Pond, Clapham Common, London.—Mr. Arthur E. Nash, 14, Angell Road, Brixton, S.W.

Liverpool Model Yacht Club.—Mr. R. Mulvey, 129, Park Road, Liverpool.

Birkenhead Model Yacht Club.—Birkenhead.

Glasgow Model Yacht Club.—Mr. D. Mc Nicol, 5, St. Clair Street, Glasgow.

Greenock Model Yacht Club.—Secretary, Greenock.

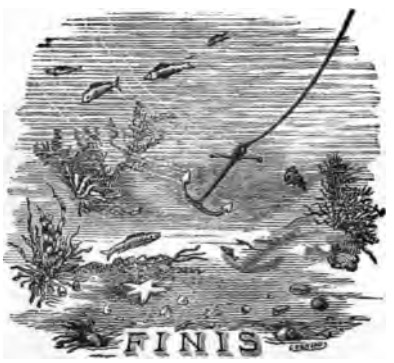
Newton Stewart Model Yacht Club.—Mr. D. Mc Arthur, Newton Stewart, N.B.

Kingston Model Yacht Club.—Mr H. F. Reynolds, 12, Milton Terrace, Hull.

Irish Model Yacht Club.—Dublin.

Model Yacht Club de Paris. Station, Bois de Boulogne, Paris.—8, Rue Drouot, Paris.

Model Yacht Club de Havre.—Havre.



APPENDIX.

AN explanation of a few of those nautical terms and phrases used by sailors, may not prove unacceptable to those readers who are not well up in maritime lingo. There are also a few other hints which may prove useful to the Model Yachtsman. They have been arranged in alphabetical order for the sake of easy reference.

Aft, or *Abaft.*—Signifies near the stern of a vessel.

Abeam.—In a line with the middle of a vessel; thus, in reference to the position of a mark or light as seen from the deck, such may be on the starboard bow, or right abeam, or on the quarter, and so on.

Amidships.—In the middle part of a vessel.

A Lee.—An order signifying something to leeward, such as "helm's a lee," meaning that the tiller has been put down to the lee side.

Athwart.—Across a vessel.

Athwart Hawse.—Across the bows.

Athwart Ships.—Across the middle part of a vessel.

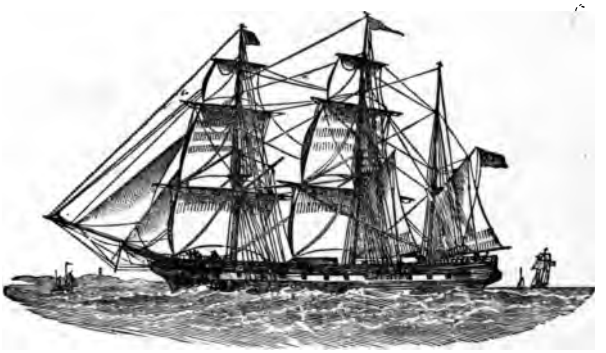
Avast.—An order signifying to stop pulling or hauling for a space.

A Weather.—A term used to signify anything on the weather side; thus, "haul jib sheet a-weather," means that the jib-sheet shall be hauled over to windward.

Adrift.—Floating at random, when a rope gets away from its fastening without breaking, it is said to be *adrift.*

Anneal.—To render less brittle and more pliable. To anneal wire, whether brass, copper or iron, put it in the fire until red hot, and let it slowly cool.

Barque or *Bark.*—A three-masted vessel, fore and aft rigged on her mizen mast only. (See cut.) A Barquentine is like a Hermaphrodite Brig, with a fore and aft mizen. A "Jackass Barque" is like a Brigantine, with a fore and aft mizen.



BARK or BARQUE.

Bear Up.—The same as bearing away, meaning to turn a vessel's head away from the wind.

Belay.—The act of making a rope fast.

Bend.—To attach; thus, "bend sails," means attach the sails in their proper places. "Bend on the halyards," means attach the halyards to the sail or spar they are to be made fast to.

Bermudian Rig.—A peculiar kind of rig used by the boatmen of the Bermuda Islands. The mast is stepped rather far forward, and the sail is cut very narrow in the head, like the sail of a sliding gunter, with sometimes a short gaff. They carry no topmast, and the jib and foresail are all in one like a sloop's staysail. The mast is much longer in proportion to the length of the boat, than is the mast of an English Cutter.

Bight.—Any part of a rope between the ends.

Bilge.—The most protuberant part of a vessel's vertical cross sections.

Bilge Keels.—Keels placed along the bilge of vessels that have to be beached frequently, in order to keep them upright when ashore. Yachts, generally use legs for this purpose, strong pieces of wood placed under the channels, or lashed alongside. Certain authorities have stated that bilge keels make a vessel more weatherly, but this has not been borne out by facts. Bilge keels are very detrimental to speed.

Board.—Used to signify the distance a vessel sails on each tack, when beating against the wind.

Binnacle.—The name given to the case or box in which the compass swings.

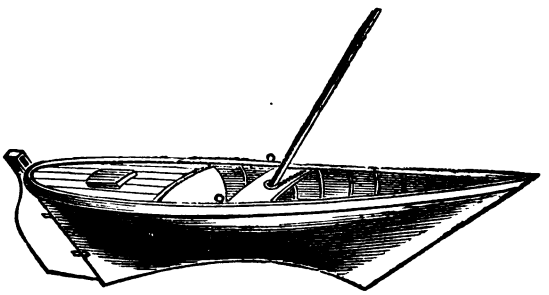
Bowline.—A rope used to extend the leach of a sail to make it set flatter. It is bent on to another piece of rope called a bowline bridle, the ends of which are attached to the leach of the sail. This brings the strain of the bowline upon two places at once, thereby stretching flat a larger surface of the sail.

Bulkhead.—A partition separating different parts of the interior of a vessel.

Brigantine.—A two-masted vessel, square-rigged forward, and schooner-rigged aft, she carries square sails on her Schooner's main-mast. (See cut.)

Bombay Fishing Boat.—A very fast craft, peculiar to the East Indies. They are very sharp forward, their greatest beam being placed about $\frac{1}{3}$ from the stern. The said stern is nearly round. Their great peculiarity is the keel, which is in the form of an arch. The mast is stepped amidships, and rakes forward, so that the head of it is plumb with the stem head. The ballast is all in the stern, and they are

rigged with a large lateen sail. Some experiments were tried with this type of vessel a few years back. The arch was filled up, and the sailing qualities of the craft immediately destroyed. They do not go to windward so well as an English Yacht, but in running and reaching they cannot be surpassed, especially in smooth water.



Black Leading.—For models, get some of the best black lead, and after gold sizeing the hull in the same manner as for bronzing, lightly go over the surface when tacky with the black lead, polishing with a soft cloth or chamois leather. A coat of varnish afterwards prevents washing off. If the mould for the keel inside, and the wooden plugs are rubbed over with a little black lead, the molten lead will not burn the wood so much.

Brig.—A square-rigged two-masted vessel. (See plate 4.)

Bunting.—A sort of light cloth used for making flags.

Bowse.—To haul taut.

Brail.—A rope passed round a sail and made fast to the mast on one side, on the other side it is led through a small block for hauling the sail close up to the mast, used generally for sprit sails.

Cable.—The rope or chain by which a vessel is anchored or moored.

Caïque.—A lateen-rigged boat used in the Mediterranean.

Canoe.—Originally used to signify a boat, having both ends alike, used by savages. Canoes are of different shapes and sizes, and are worked by a double-ended oar called a paddle. The Indians sometimes hollow them out of the single trunk of a tree. In New Zealand they are ornamented with elaborate carvings. The Greenlanders make them of skins and cover them in, leaving a hole for the sitter, so that they are comparatively water tight. In England, of late years, a class of boats have sprung up, called Canoes, introduced by Captain Rob Roy Macgregor, who crossed the Channel in one. They are fitted with sails for racing and cruising, lead ballast, centre boards, sliding keels, etc. For full description of Canoes and Canoeing, see Mr. Dixon Kemp's work "Yacht and Boat Sailing." A small Duplex Sailing Machine might be superior to any Canoe in speed, and weatherliness and the comfort on either would be about equal.

Cat Boat.—A small centre-board boat used in the United States for pleasure sailing. They are very broad and shallow. The mast is

stepped close up to the stem, and they carry one large sail like the mainsail of the American Sloop. They are excessively dangerous in inexperienced hands. A somewhat similar craft called the Una boat, is occasionally seen at English watering places.

Cheeks.—Projections at the lower part of the mast-head on which the crosstrees and trestletrees rest, sometimes called hounds.

Close hauled.—Means that the sails are set flat at a small angle, in order to sail close to the wind.

Companion.—The entrance to the cabin from the deck.

Cuddy.—A small cabin generally between the main cabin and the forecastle.

Caulk.—To make the seams of a vessel water-tight.

Coxswain.—The person who steers or has charge of a rowing boat.

Catheads.—A projecting timber on each side of the bow of large vessels, with sheaves through which a tackle is rove, used for securing the anchor.

Cheerily.—Signifying willingly, heartily.

Capstan.—A sort of turntable on the deck with holes cut in the top for wooden bars to fit in. The crew lay hold of the bars and push the capstan round. It is used for getting a stronger purchase upon a rope than can be obtained by mere hauling. Patent capstans are now sometimes used to weigh the anchor.

Cleat.—A wooden projection used for belaying a rope to. Cleats are usually placed fore and aft. Belaying pins vertical. The latter are generally iron.

Crank.—Unstable, inclined to fall over.

Crance.—The iron on the bowsprit end to which the shrouds and bobstay are hooked. In models, the ring through which the bowsprit is shipped in the stem, is generally called the crance, although erroneously.

Cringle.—A small metal ring with a groove round its outer edge. It is used on the outer edge of a sail for passing the reef earing through. It is also jammed into the strop of a block when an eye is wanted, for the purpose of hooking the block on to anything. It is sometimes called a thimble.

Ceylon Fishing Boat.—A craft used by the Cingalese in the Island of Ceylon for fishing. The bottom is round like a spar, only turned up in the ends. The top sides are perpendicular. They are very narrow and are kept upright by means of an outrigger, a round, solid piece of spar sharpened at both ends, secured to the boat by beams of bamboo. They carry a large lugsail, and are steered with an oar.

Crutch.—Cross pieces of wood used to rest the boom in when the sail is down.

Dandy.—A vessel, cutter or sloop rigged, with the addition of small mizen mast at the stern. A lug or spritsail is set upon the mizen mast. Of late years this class of craft has generally been termed a Yawl. (See Yawl.)

Davit.—A sort of stanchion used for hoisting up boats to the side of a vessel.

Drift.—The length of rope over and above that which is really utilised. It is always advisable to have some drift in sheets and halyards. Used also to signify the set of a tide or current, and a vessel's leeway.

Dead Eye.—A circular piece of wood with three holes in it through which the lanyards of the rigging are passed. When there is only one hole in them they are called bulls-eyes.

Double Banked.—Signifies that a boat is being rowed by two men sitting on the same thwart.

Dowse.—To lower away suddenly. To put out quickly, as "Dowse that glim," meaning "Put out that light."

Downhaul.—A rope fitted to the upper part of a sail to haul it down by.

Drag.—Excess of draught of water aft, over that forward.

Diagonal Lines.—Lines used by some Naval Architects in designing a vessel instead of buttock and futtock lines. They are drawn first in the body plan diagonally across and then laid off in the sheer and half breadth plans.

"*Easy There.*"—Signifying not to pull or haul strongly.

"*Ease up handsomely.*"—Means to let go gradually so as not to lose command over the rope which is being cast off, or the sail that is being lowered.

Earing.—A rope attached to the clews or cringles of a sail to fasten them to the ends of the yards or booms.

Felucca.—A craft used in the Mediterranean. Some of them are half-decked, but many are open fore and aft, and are rigged with one, but often with two or more masts carrying lateen sails.

Fender.—A piece of cork, wood, or stuffed canvas or matting, used for preventing the sides of a vessel from getting chafed against a pier or another vessel.

Full and By.—Sailing close to the wind without shaking.

Flukes.—The part of the anchor which sticks in the ground. The main part of an anchor is called the shank, and the cross piece the stock.

Fish Tackle.—A powerful tackle used on board ships to hoist the anchor on to the bow.

Galley.—An old-fashioned vessel propelled by oars, occasionally seen in the Mediterranean. The oars are worked by convicts. Condemning a prisoner to the galley used to be considered worse than sentencing him to death. The place where the cooking is done on board a vessel is also styled the galley, although the proper name is the caboose.

Gammon Iron.—The iron ring in the stem through which the bowsprit passes.

"*Give Way.*"—Meaning pull the oars hard when rowing.

Gaskets—The lashings round a sail after it is furled or rolled up.

Garboards.—That part of a vessel's bottom nearest the keel on each side.

Goose Winged.—Used to signify that a vessel is running dead before the wind, with her sails set on opposite sides.

Gores.—Narrow cloths inserted in sails to prevent them from stretching in certain places.

Guy.—A rope for keeping a boom on one side of a vessel.

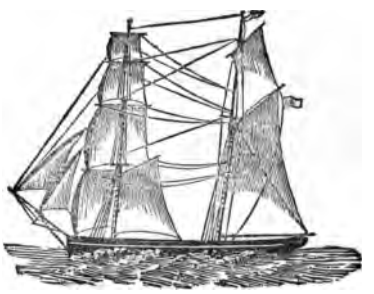
Grummet.—A piece of rope shaped like a ring.

Gold Size Putty.—A useful putty for Model Yatchsmen, made by mixing some best Japan gold size, with ground whiting, until it is the consistency of common putty. The surface it is laid on should have a coat of paint previously to the putty being applied as it makes it bite. This putty will dry hard in from one to two hours, and can then be glass papered and painted. The whiting should be well dried before being mixed with the gold size.

Gybe.—The act of shifting the sails from one side to the other, when running before the wind.

Hatch.—A close covering over an opening in the deck. In models hatches are made in different ways. The best are sliding hatches. Make the combings or ledges at the sides of the opening in the deck stout enough to take a deep groove, and fit a sliding lid close enough to be watertight; this hatch is, in fact, similar to the common paint boxes, seen in shop windows. Another way is to put a cork ledge round the opening in the deck, and fit a cork lid neatly into this, fastening to the cork lid a thin piece of board, with enough wood projecting round the cork to prevent the latter slipping down inside the boat. A little common candle grease round a hatch will tend to keep it watertight while sailing.

Hermaphrodite.—A name given to a two-masted vessel, square-rigged forward, and fore and aft-rigged at the main. She differs from a brigantine in having no square sails on her main topmast. (See cut). She is sometimes erroneously called a Brigantine.



"*Heave to.*"—Means to place the sails in such a position as to keep a vessel just dodging head to wind, called by sailors "laying to." Some vessels will not "lay to" at all well, while others will ride out the heaviest gale in this manner as comfortably as if they were at anchor.

Hawser.—A large rope used for towing and other purposes.

Hawse Pipe.—The holes in the bow through which the cable leads.

Hogged.—Means that the ends of a vessel droop, or are lower than the middle. This is very ugly, and a perfectly straight vessel will have

the appearance of being slightly hogged, unless she has a little sheer up in the ends.

House.—To lower down, such as "house the topmast," meaning lower it down so that it is almost on a level with the mast. That part of the mast which is under the deck is also said to be housed.

Hoy.—A name formerly given to a class of pleasure boats used on the Thames. In their build they formerly resembled the Bawley and Hatch fishing boats. A name also given to those Government dock-yard Lighters which are cutter rigged.

Jamming hitch.—To make a rope fast so that the greater the strain the tighter the turns become.

Jury mast.—A temporary mast, fitted when the other is carried away.

Junk.—Old rope. A name also given to Chinese vessels which have great sheer and are very clumsy looking craft.

Knittles or Nettles.—Small lashings used for lacing light sails to their spars. Also used by modern Yachtsmen, to signify reef points.

Knot.—A nautical mile, 2,026 yards, the statute mile is equal to 1,760 yards.

Lanyard.—A small piece of rope used for fastening the rigging to the dead-eyes.

Launch.—To let a vessel slide into the water. A superior kind of open boat carried by large vessels.

Leeward.—The side opposite to that from which the wind blows.

Leeway.—The distance a vessel loses when blown sideways by the wind.

Lazy guy.—A rope used for keeping a boom from jumping in a sea.

Log line.—A measured line used for ascertaining the speed of a vessel through the water.

Lead line.—A line divided into fathoms (6 feet) with a lump of lead at one end for measuring the depth of water.

"*Luff.*"—Signifying to bring a vessel closer to the wind.

Marline spike.—An iron spike used by sailors to open the strands of rope for splicing, etc.

Midships.—The middle of a vessel.

Miss Stays.—Means that a vessel fails to come round on the tack opposite to that she is being sailed upon, when the helm is put down

Moor.—To ride with two anchors down.

Mouse.—To lash a small piece of spunyarn or marlin round the hook of a block, to prevent its slipping out of the eye.

Meet Her.—An order given to the helmsman, signifying put the helm the opposite way, in order to prevent the head of the vessel coming up or falling off too much.

"*No Nearer.*"—An order to the helmsman, meaning "don't bring the vessel any closer to the wind."

Nock.—That corner of a fore and aft gaff sail which is fast under the jaws of the gaff.

Offing.—The space between a vessel and the shore.

Overhaul.—To lengthen a tackle by hauling the slack rope through

the blocks. Also used by sailors to signify a careful examination of anything.

*Painter.*The rope used for towing the dinghy or punt astern of a Yacht, also for making a small boat fast to a larger vessel.

Palm.—A leather going round the palm of the hand, with a thimble in the middle, used by sail makers.

Pawl.—An iron wedge, to prevent a windlass or capstan from turning round the opposite way to that which is wanted.

Parcelling.—Tarred canvas, wound round a rope to prevent chafe.

Paying off.—Means that the head of the vessel is turning away from the wind.

Pintles.—The hooks on the rudder which fit into eyes, called gudgeons, on the sternpost.

Pinnace.—An eight-oared boat used in ships of war and other large vessels.

Port.—The left-hand side of a vessel.

Polacre.—A Mediterranean vessel, sometimes square rigged on her fore and main masts, with lateen aft. Her lower masts, topmasts, and topgallant masts are, however, all in one. A polacre brig is square rigged forward and lateen aft.

Purchase.—The multiplied power obtained by a tackle.

Pram.—A Norwegian vessel with a bow something like a Thames Dumb Barge.

Ratlines.—Small stuff which cross the shrouds, forming steps to go aloft by.

Razee.—To cut down. To make a vessel small by taking off some of the topside.

Reef.—To reduce sail by tying up the lower part.

Reeve.—To pass a rope through thimbles, or eyes, or the sheave-holes of a block.

Ringtail.—An extra sail carried along the after leach of the main-sail, for running in light airs.

Rowlocks.—Used in some boats—instead of thole pins, which are merely straight pieces of wood—to rest the oars in. They are metal, generally brass or galvanized iron.

Sampan.—A boat used in China. It has two masts fitted with sails made of matting with bamboo battens across them to keep them flat.

Scud.—To run before the wind.

Scull.—A light oar. To propel a boat by means of one oar in the stern.

Scuppers.—Openings in the lower part of the bulwarks to let the water run off.

Scuttle.—A small hatch. To cut holes in a vessel to let the water in.

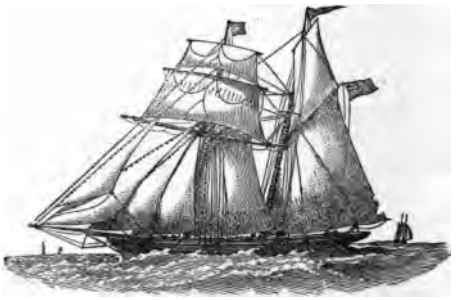
Shallop.—An old name for a ship's long boat.

Seize.—To lash anything with small stuff, such as spunyarn, marlin, &c.

Serve.—To warp spunyarn round a rope, to prevent chafe. Worming is to wind spunyarn or marlin in between the strands of a rope.

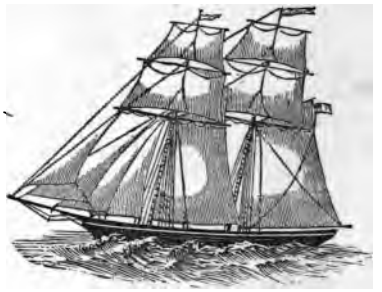
Sheave.—The roller inside a block.

Sheet Anchor.—The largest and strongest anchor on board a vessel.

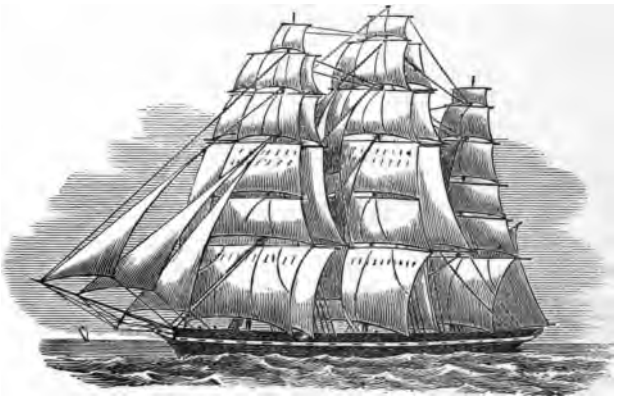


Schooner.—Fore and aft, See Plate 2, also woodcut on Title. Topsail Schooner carries a topsail and tog-gallant sails forward. See cut.

A two-topsail Schooner has square sails on both her topmasts. See cut.



Ship.—A vessel with three masts, square-rigged upon all three of them. See plates 7, 8 and 9. Modern ships are generally fitted with double topsail yards, that is, the topsails are cut in half, and a yard fitted to the lower part, so that when the upper topsail is furled, the sail is like a close reefed topsail. Double topgallant yards are also occasionally seen.



Skeet.—To wet the sails of a vessel to make them stand flatter.

Spencer.—The fore and aft fore and main sails in square rigged vessels.

Spanker.—The fore and aft gaff sail set on the mizen mast in a ship or barque.

Snorter.—The loop or ring into which the lower part of a sprit is inserted.

Starboard.—The right hand side of a vessel.

Stand by.—An order signifying be ready.

Stunsails.—Sometimes called steering sails, are sails carried on square rigged vessels to increase the spread of canvas when running before the wind. (See cut of full rigged ship.)

Snow.—A brig with a small mast abaft the mainmast called a trysail mast, on which the fore and aft mainsail, or more properly speaking, the driver is set.

Sweep.—A long oar.

Tail block.—A block with a piece of rope spliced to it, to fasten it in any place where it is wanted.

Toggle.—A piece of wood fastened to a rope with a loop in the other end, called a becket. In a model, a piece of wood or wire used to set up rigging. The rope is led through a hole in one end of the toggle, passed through the eye of a hook, and the end taken up through another hole in the toggle and knotted, so that it cannot slip through. Hook the rope on to its place, and slip the toggle up till it is taut, it will remain so.

"*Top your boom.*"—Meaning clear out, get out of the way.

Tacking.—Beating to windward.

Thwarts.—The seats across a Rowing Boat.

Trysail.—A small, narrow-headed fore and aft sail, used for stormy weather instead of a close reefed mainsail. In model sailing a trysail is a very useful sail in blowing weather. Instead of a close reef with jib-headed topsail set over it, see Plate 3, a trysail may be set. The trysail gaff should be about one-third the length of the main gaff, the foot of the sail reaching to the taffrail and set on a boom, or it will not stand. A model will sail better in a gale of wind under a trysail than with a close reefed mainsail, the weight of the tied up wet cloth and long-gaff being detrimental. The trysail should be equal in hoist to the mainsail with one reef in it.

Truck.—The circular top of a vessel's mast.

Trip.—To break an anchor out of the ground.

U Bow.—A sort of bow advocated by Sir E. J. Reed, C.B., the late Chief Constructor of the Navy. Its chief characteristic is that the vertical cross sections of the fore body are as full at the lower part of the entrance as they are at the top. In fact, they take the form of the letter U; hence its name. With respect to the merits of this form of entrance, Naval architects are divided in opinion; but Yacht builders have condemned it in *toto*. As already observed, the finer the entrance *under water*, the faster and more weatherly a vessel will be. Good buttock and futtock lines cannot be obtained with an U bow.

Unbend.—To cast off a rope or sail altogether.

Unship.—To remove anything out of a vessel.

Veer and Haul.—Slacking away a rope for the purpose of getting

another pull upon it. The wind is said to veer when it changes with the course of the sun, and is said to back when it shifts in a direction contrary to the sun's course.

Wake.—The line of water astern of a vessel, disturbed by her passage through it.

Warp.—To tow a vessel along by pulling at a rope fast to a fixed object. A strong rope.

Watch.—The divisions of sea time. Thus, a watch is four hours. The dog watches are from 4 to 6 and from 6 to 8 in the evening. These change the watches, so that the crew have an equal amount of rest on alternate nights. The bells are struck every half-hour, beginning at one bell and ending at eight bells, when a new watch begins.

"*Watch, ho Watch.*"—The cry of the leadsman in the bow when he is heaving the deep sea, pronounced dip-sey, lead.

Water Sails.—Sails set underneath the foot of fore and aft sails in very light wind. They are only useful when running before the wind.

Wearing.—Putting a vessel before the wind for the purpose of changing her tack. This manœuvre is only resorted to when a vessel refuses to come about, but falls off on the same tack directly she is brought head to wind.

White Decks for Models. How to make them.—After smoothing the piece of pine chosen, which should be clear grained and free from knots, go over it carefully with some dry, clean whiting, rubbing it well in. Dust it off and then melt a piece of common size, such as is sold at the oilshops, in a cup of boiling water. Don't let it be too thick, but about the consistency of thin gum. With a clean brush coat the deck carefully and let it dry. When thoroughly dry, give it a light rub with No. 0 glass paper. The deck can now be ruled for the seams, fitted on and varnished in the ordinary manner. It will keep its colour much longer than when the varnish is applied direct to the wood. Some use horse chestnut wood for decks, but this warps very much and is troublesome to work. A coat of white French polish over the wood before varnishing will also tend to keep it white, but it is not so effective as the above plan.

Yawl.—Formerly a double-ended open boat, used for fishing on the coasts. Also a boat used by war ships. Now, the name is given to dandy-rigged Yachts. See Plate 6.

Zebec.—A Mediterranean boat, very swift and light, but wide and roomy. Lateen rigged.

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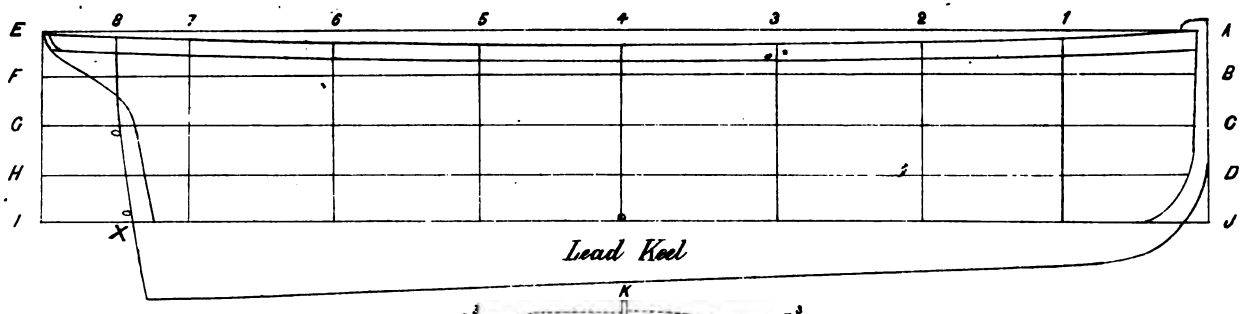
PLATE I.

Fig 1.



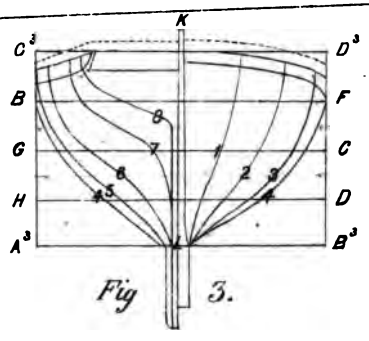


Fig 3.

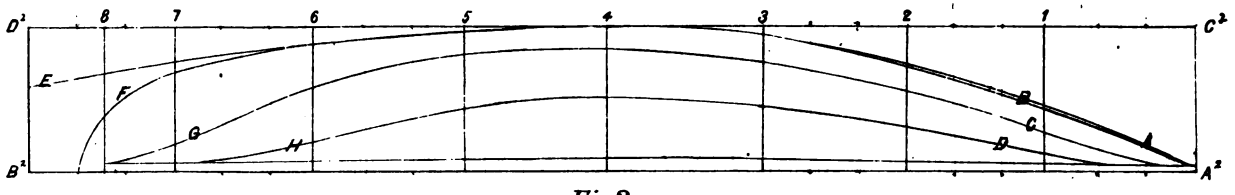


Fig 2.

PLATE III.

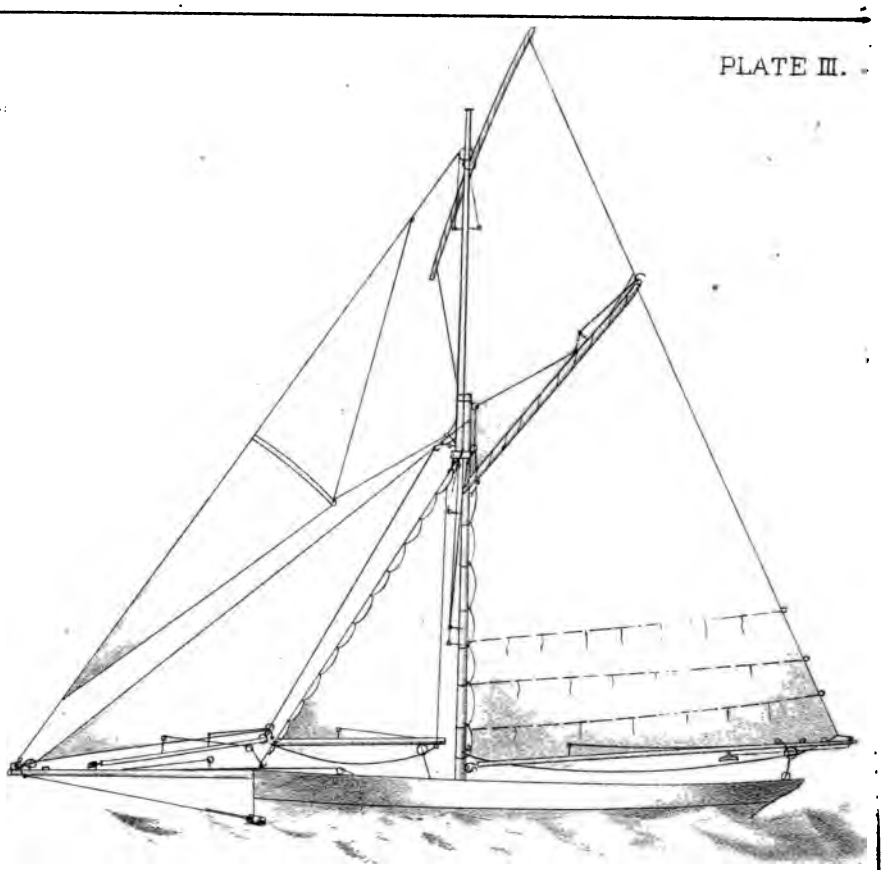


Fig. 1.

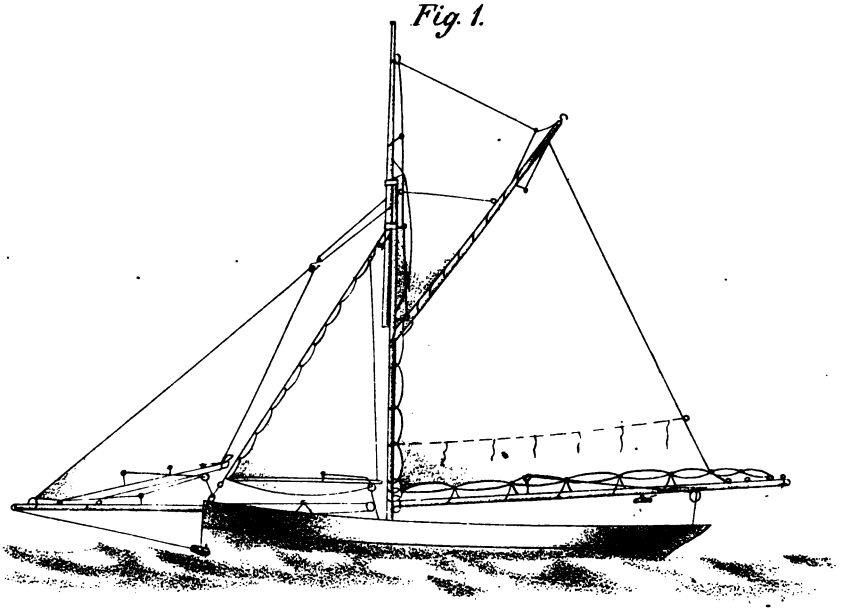
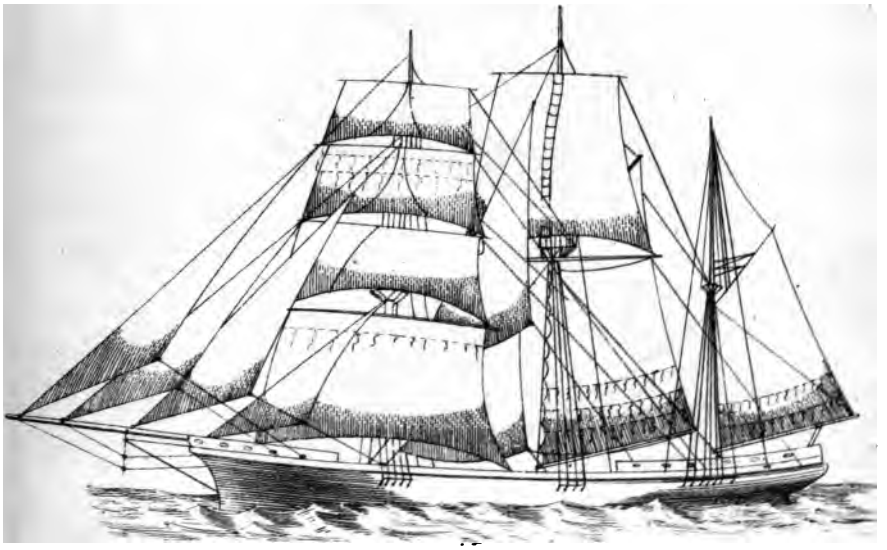
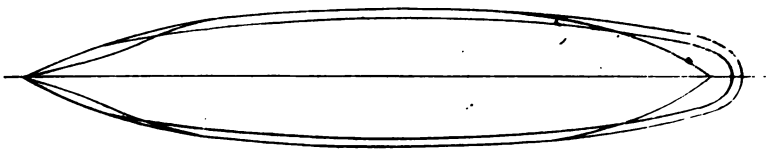


Fig. 2.

PLATE IV.

A BRIG





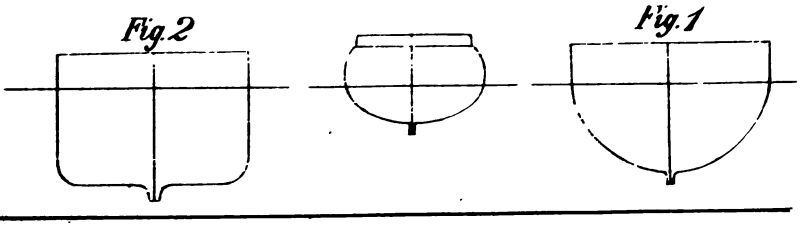
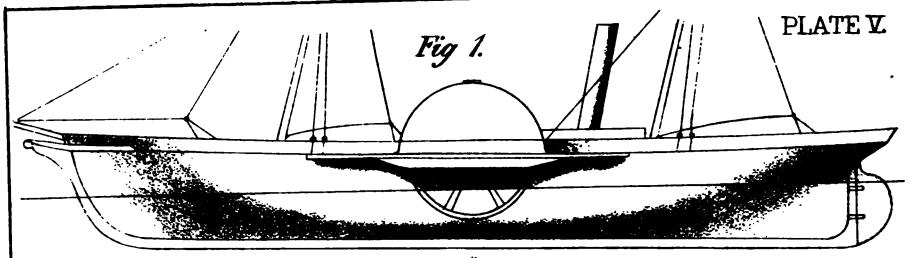


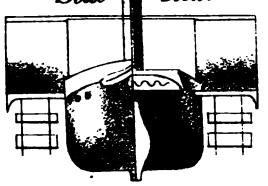
PLATE V.

Fig 1.



Side view.

View



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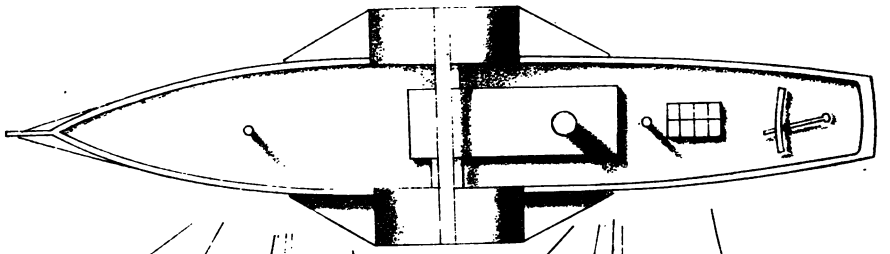

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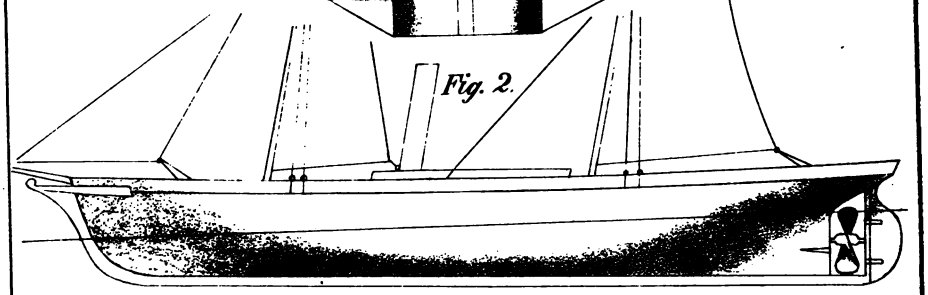
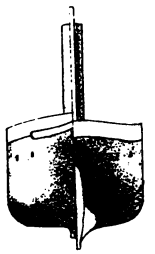


View



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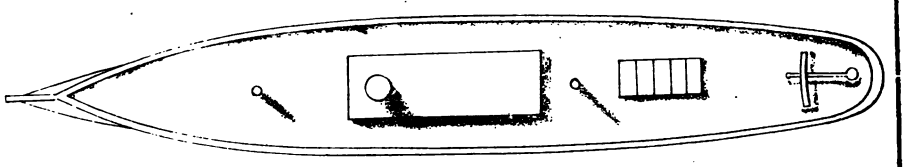
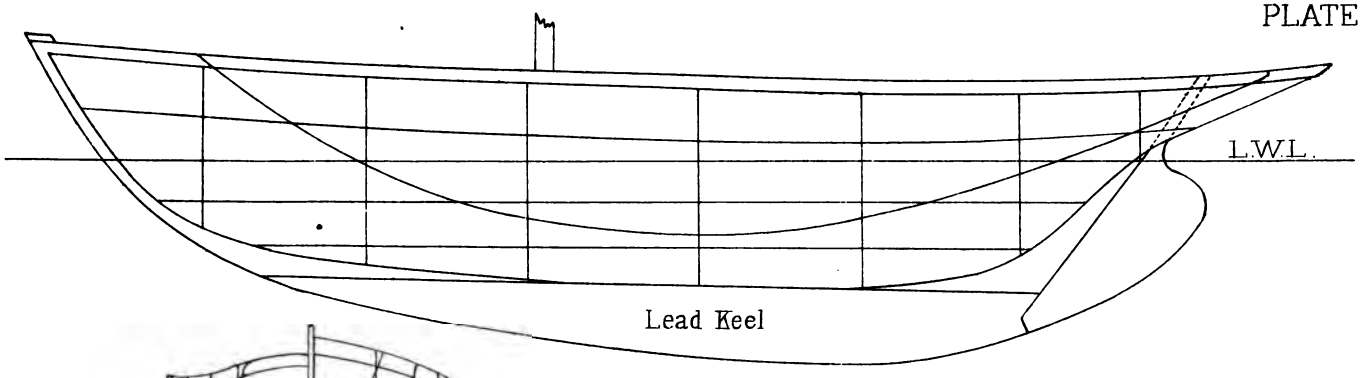
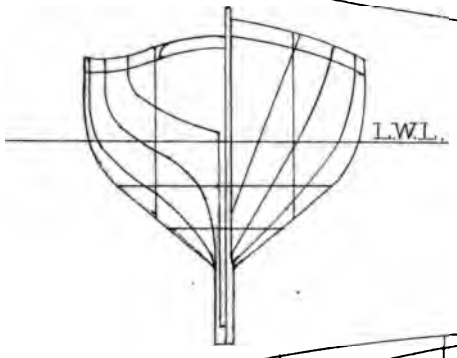
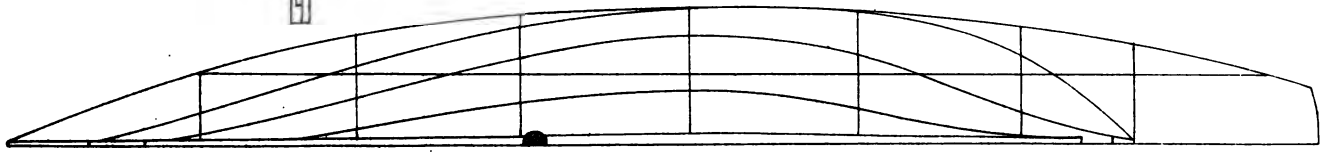


PLATE V.







Scale of Feet for 10 Tonner Y. R. A. M. 1882.

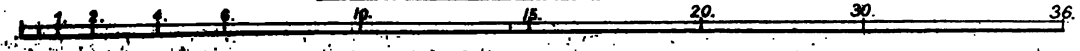
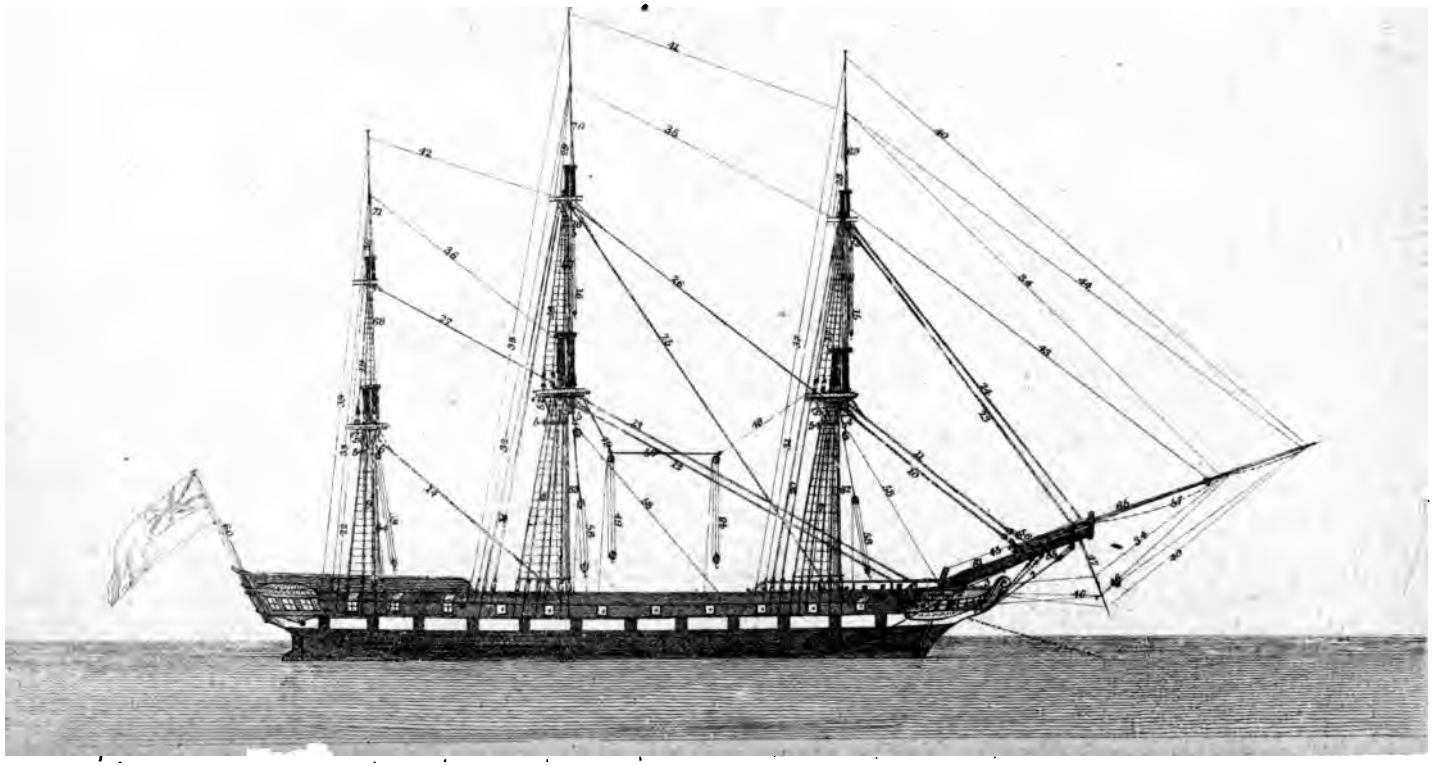
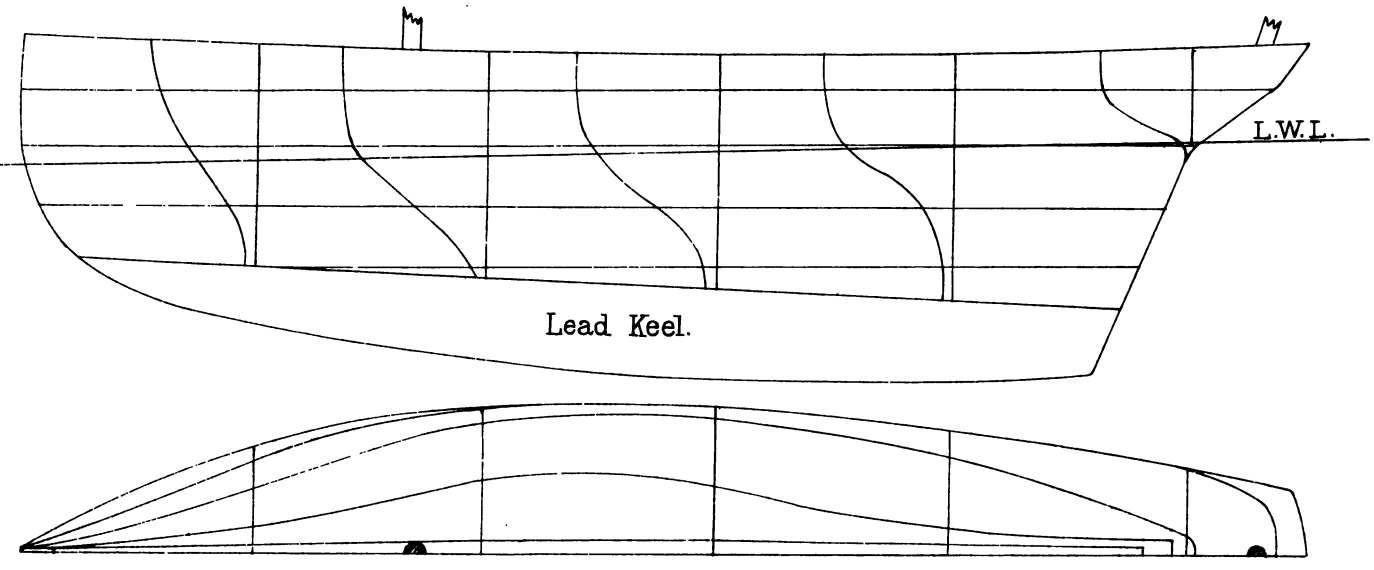


PLATE VII.

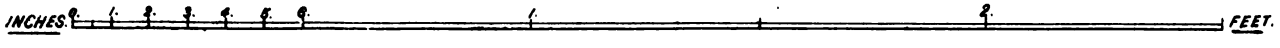
STANDING RIGGING.



PL A.

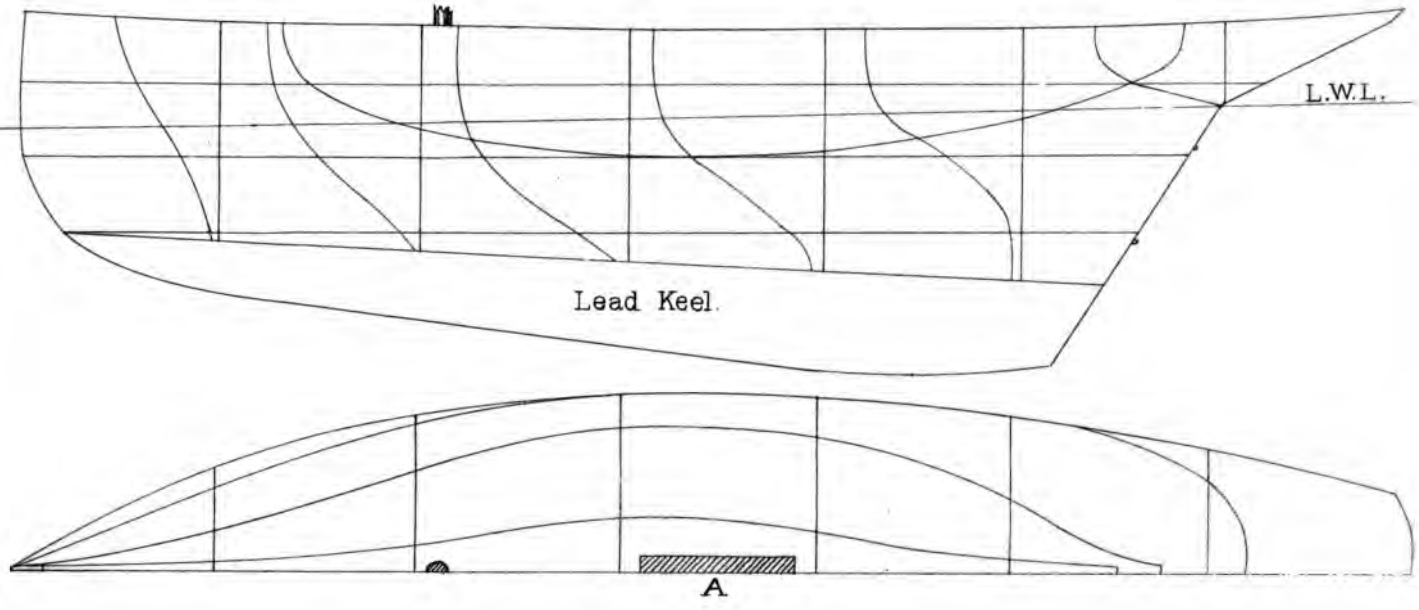


—Scale of Feet.—



DESIGN FOR A 2 FT 6 IN. YAWL ON M.Y.S.A. MEASUREMENT.

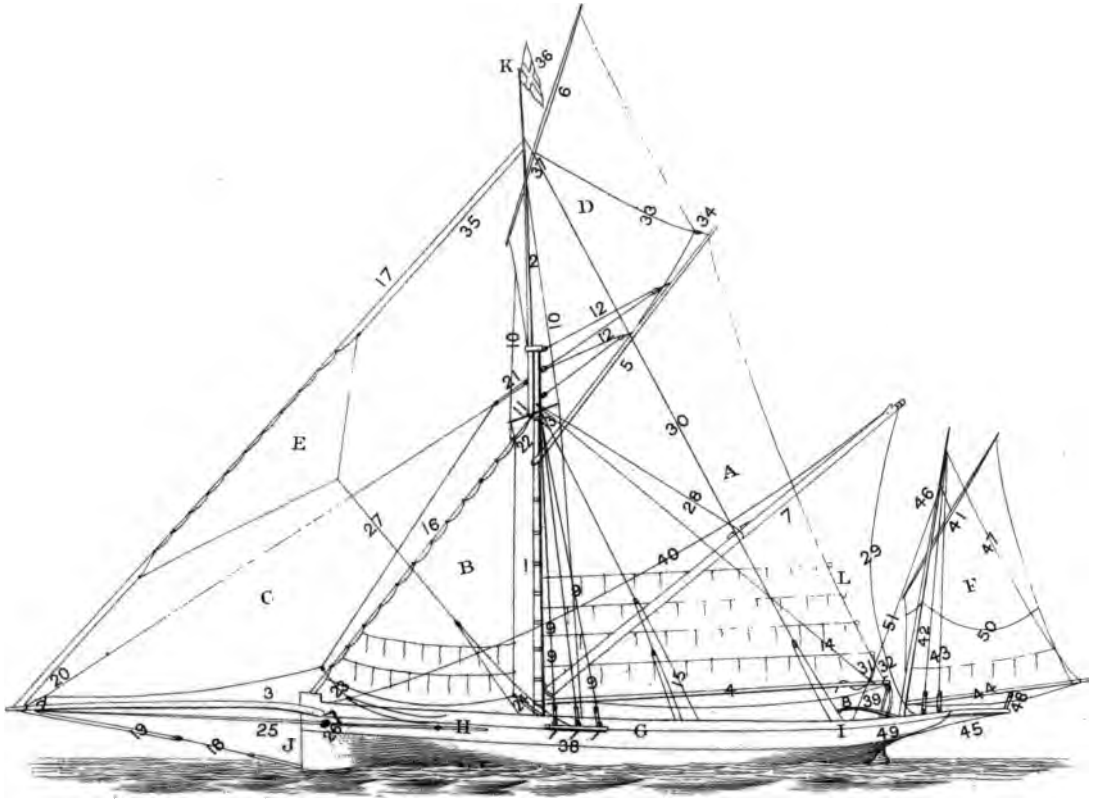
PLATE XI.



— Scale of Feet. —

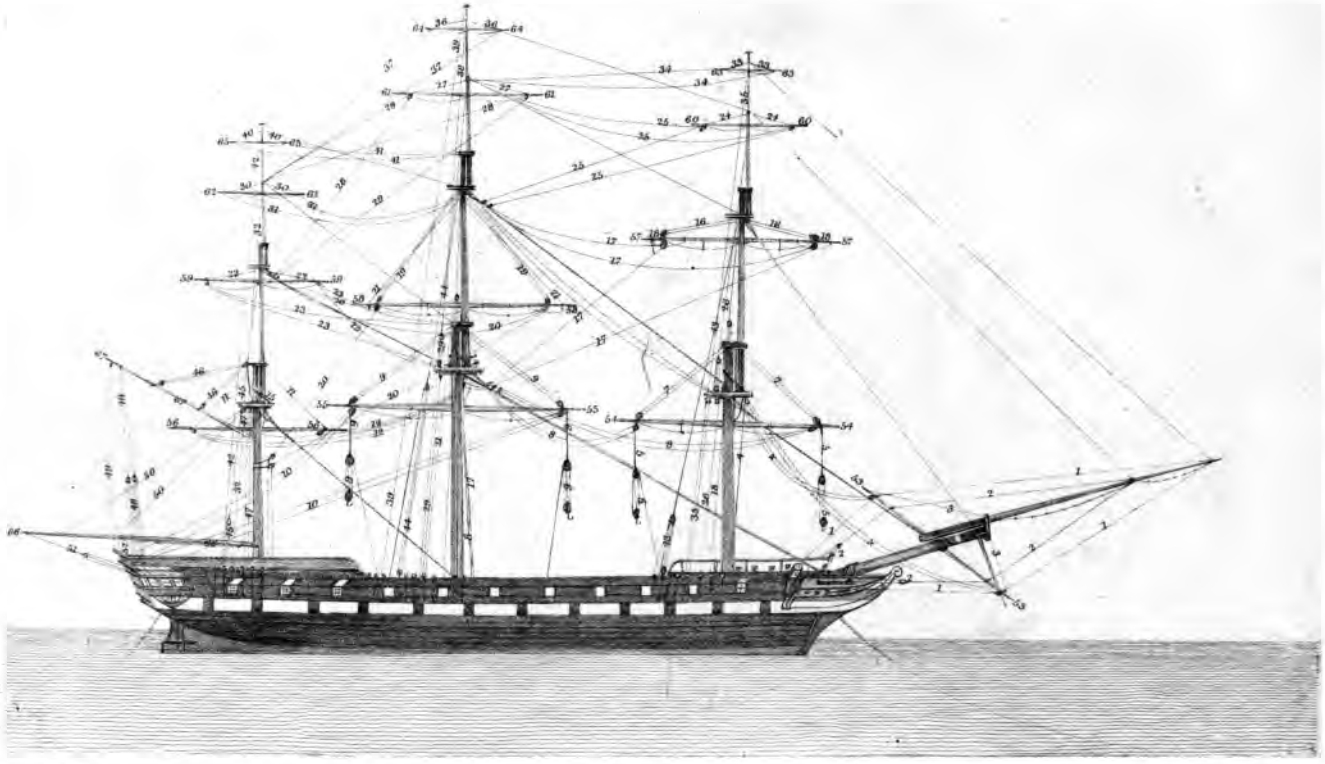
DESIGN FOR A 3Ft CUTTER ON L.W.L. MEASUREMENT.

Plate XII



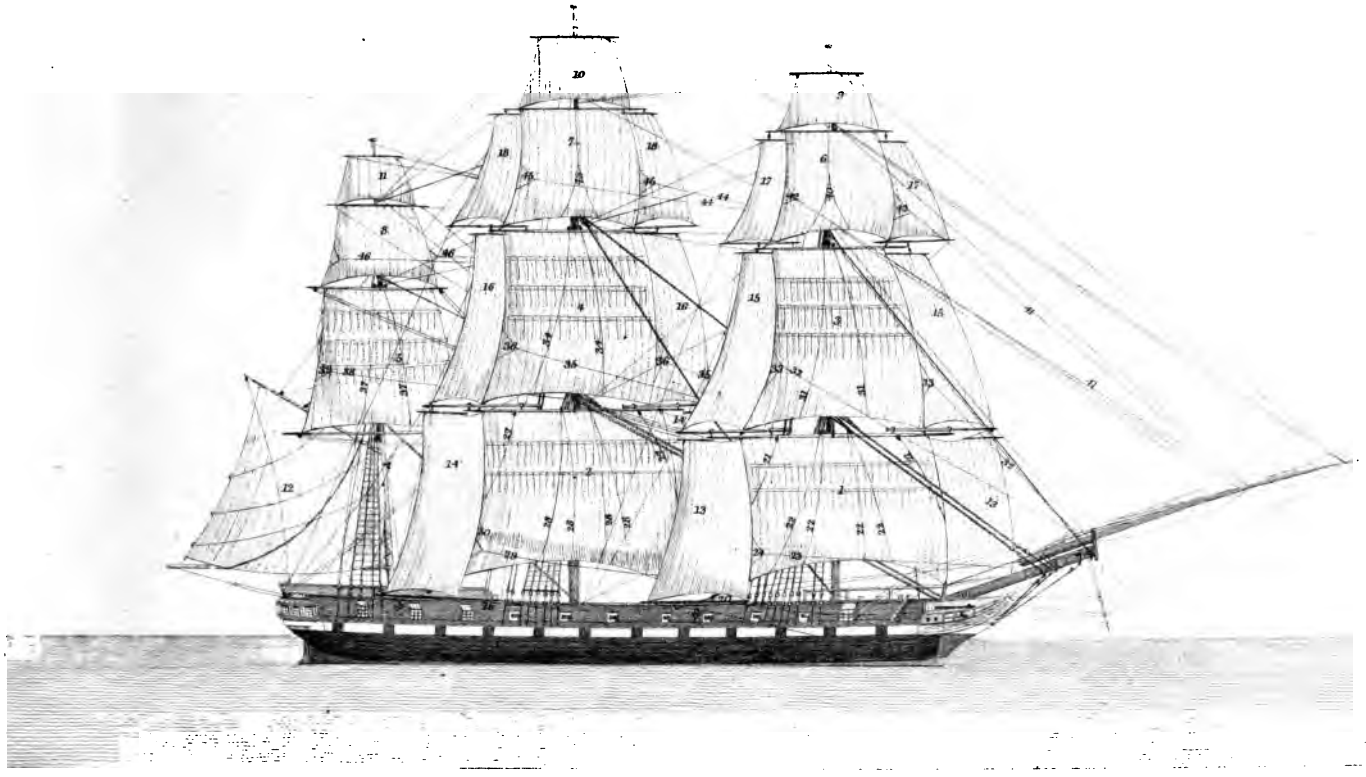
RUNNING RIGGING.

PLATE VIII.



SQUARE SAILS AND DRIVER.

PLATE IX.



ROPES, SPARS, & SAILS OF A YAWL & SCHOONER.

YAWL'S SPARS AND ROPES.

1. Lower mast and hoops.
2. Topmast.
3. Bowsprit.
4. Main boom.
5. Gaff.
6. Topsail yard.
7. Spinnaker boom.
8. Tiller.
9. Shrouds.
10. Topmast shrouds.
11. Crosstrees.
12. Peak halliards.
13. Throat or Main halliards.
14. Boom Topping lift.
15. Runners and tackles.
16. Forestay.
17. Topmast stay.
18. Bobstay.
19. Bobstay fall.
20. Jib traveller.
21. Jib halliards.
22. Fore halliards.
23. Jib sheets.
24. Fore sheet.
25. Bowsprit shrouds.
26. Whiskers.
27. Jib topsail sheet.
28. Spinnaker boom topping lift.
29. Spinnaker boom brace.
30. Maintopmast backstay.
31. Reef Pennant.
32. Main outhaul.
33. Gaff topsail clew line.
34. Gaff topsail sheet.
35. Jib topsail halliards.
36. Burgee.
37. Gaff topsail halliards.
38. Channels.
39. Main sheet.
40. Spinnaker boom guy.
41. Yard.
42. Mizen Mast.
43. Mizen Shrouds.
44. Mizen boom.
45. Bumpkin and Bumpin shrouds.
46. Mizen halliards.
47. Mizen Topping Lift.
48. Mizen sheet.
49. Counter.
50. Brails.
51. Mizen Stays.

SAILS, &c.

A. Mainsail.
B. Foresail.
C. Jib.
D. Gaff topsail.
E. Jib topsail.
F. The mizen.
G. Midships.
H. Forecastle.
I. The quarter.
J. Stem, Cutwater.
K. Truck.
L. Reef Cringles.

A Cutter is the same without the mizen.

SCHOONER'S SPARS AND ROPES.

1. Mainmast.
2. Foremast.
3. Bowsprit.
4. Main boom.
5. Maintopmast.
6. Foretopmast.
7. Main Gaff.
8. Fore Gaff.
9. Maintopsail yard.
10. Foretopsail yard.
11. Main toppinglifts.
12. Davit falls.
13. Davits.
14. Main shrouds.
15. Fore shrouds.
16. Forestay.
17. Bowsprit shrouds,
18. Foretopmast stay.
19. Jib sheet.
20. Bobstay.
21. Fore peak halliards.
22. Main peak halliards.
23. Main throat halliards.
24. Fore throat halliards.
25. Forestaysail sheet.
26. Fore crosstrees.
27. Main crosstrees.
28. Jib traveller.
29. Jib halliards.
30. Triatic stay.
31. Maintopmast stay.
32. Ensign halliards
33. Fore channels.
34. Main channels.
35. Tiller.
36. Main Sheet.
37. Reef pennant.
38. Reef points.
39. Maintopsail sheet.
40. Maintopmast staysail sheet.
41. Ensign.
42. Fore Sheets.
43. Fore Runner and Tackle.
44. Main Runner and Tackle.

SAILS, &c.

A. Mainsail.
B. Foresail.
C. Fore staysail.
D. Jib.
E. Maintopsail.
F. Foretopsail.
G. H. I. Reef Cringles.
J. Maintopmast staysail.

NOTE.—*In Sails, the lower fore corners are called the tacks, and the after corners the clews; of the sides, the upper part is the head; the lower, the foot; the fore part, the luff; the after part, the leach.*

STANDING RIGGING OF A MERCHANT SHIP. (*Plate 7.*)

1 Gammoning.
2 Bobstays.
3 Bowsprit-shrouds.
4 Fore-tackle pendants.
5 Main-tackle pendants.
6 Mizen-burton pendants.
7 Fore-shrouds, or fore-rigging.
8 Main-shrouds, or main-rigging.
9 Mizen-shrouds, or mizen-rigging.
10 Fore-preventer stay.
11 Fore-stay.
12 Main-preventer-stay.
13 Main-stay.
14 Mizen-stay.
15 Fore-top-mast burtons and pendants.
16 Main-top-mast burtons and pendants.
17 Fore-top-mast rigging.
18 Main-top-mast rigging.
19 Mizen-top-mast rigging.
20 Fore-top-mast standing backstays.
21 Main-top-mast standing backstays.
22 Mizen-top-mast backstay.
23 Fore-top-mast preventer stay.
24 „ „ stay.
25 Main-top-mast preventer stay.
26 „ „ stay.
27 Mizen-top-mast stay.
28 Fore-top-gallant rigging, or shrouds.
29 Main-top-gallant rigging, or „
30 Mizen-top-gallant rigging, or „
31 Fore-top-gallant standing backstay.
32 Main-top-gallant standing backstay.
33 Mizen-top-gallant backstay.
34 Fore-top-gallant stay.
35 Main-top-gallant stay.
36 Mizen-top-gallant stay.
37 Fore royal backstay.
38 Main royal backstay.
39 Mizen royal backstay.
40 Fore royal stay.
41 Main royal stay.
42 Mizen royal stay.
43 Standing jib stay, or jib stay.
44 Flying jib stay.
45 Bowsprit-horse.
46 Martingale.
47 Dolphin striker, or martingale boom.
48 Fore-stay tackle.
49 Main-stay tackle.
50 Span for tackle.
51 Fore futtock shrouds.
52 Main futtock shrouds.
53 Mizen futtock shrouds.
54 Futtock staves.
55 Bobstay collars.
56 Fore-stay collars.
57 Jib-boom horses.
58 Fore and main runners and tackles.
59 Mizen-burtons.
60 Ensign-staff and halliards.
61 Bowsprit.
62 Fore-mast.
63 Main-mast.
64 Mizen-mast.
65 Jib-boom.
66 Fore-top-mast.
67 Main-top-mast.
68 Mizen-top-mast.
69 Fore-top-gallant-mast.
70 Main-top-gallant-mast.
71 Mizen-top-gallant-mast.
72 Bumpkin.

RUNNING RIGGING OF A MERCHANT SHIP. (*Plate* 8.)

1 Flying jib-guys.
2 Standing jib-guys, or jib-guys.
3 Sprit-sail lifts.
4 Sprit-sail braces.
5 Fore-yard tackles.
6 Main-yard tackles.
7 Fore-lifts.
8 Fore-braces.
9 Main-lifts.
10 Main-braces.
11 Cross-jack lifts.
12 Cross-jack braces.
13 Slings of fore-yard.
14 Slings of main-yard.
15 Slings of cross-jack-yard.
16 Fore-top-sail-lifts.
17 „ „ braces.
18 „ „ reef-tackles.
19 Main-top-sail-lifts.
20 „ „ braces.
21 „ „ reef-tackles.
22 Mizen-top-sail-lifts.
23 „ „ braces.
24 Fore-top-gallant-lifts.
25 „ „ braces.
26 „ „ halliards.
27 Main-top-gallant-lifts.
28 „ „ braces.
29 „ „ halliards
30 Mizen-top-gallant-lifts.
31 „ „ braces.
32 „ „ halliards
33 Fore-royal-lifts.
34 „ braces.
35 „ halliards.
36 Main-royal-lifts.
37 „ braces.
38 „ halliards.
39 Signal halliards.
40 Mizen-royal-lifts.
41 „ braces.
42 „ halliards.
43 Fore-top-sail tie and halliards.
44 Main-top-sail tie and halliards.
45 Mizen-top-sail tie and halliards.
46 Mizen-gaff peak halliards, or spanker-peak halliards.
47 Mizen-gaff throat halliards.
48 Mizen-vang-pendants and falls, or spanker-vangs.
49 Mizen-signal halliards, or ensign halliards.
50 Spanker-boom topping-lift.
51 „ „ quarter guys.
52 „ „ sheet.
53 Sprit-sail-yard.
54 Fore-yard.
55 Main-yard.
56 Cross-jack yard.
57 Fore-top-sail-yard.
58 Main-top-sail-yard.
59 Mizen-top-sail-yard.
60 Fore-top-gallant-yard.
61 Main-top-gallant-yard.
62 Mizen-top-gallant-yard.
63 Fore-royal-yard.
64 Main-royal-yard.
65 Mizen-royal-yard.
66 Spanker boom.
67 „ gaff.

SQUARE-SAILS AND DRIVER OF A MERCHANT SHIP. (*Plate* 9.)

1 Fore-course, or fore-sail.
2 Main-course, or main-sail.
3 Fore-top-sail.
4 Main-top-sail.
5 Mizen-top-sail.
6 Fore-top-gallant-sail.
7 Main-top-gallant-sail.
8 Mizen-top-gallant-sail.
9 Fore-royal.
10 Main-royal.
11 Mizen-royal.
12 Driver, or spanker.
13 Fore-lower-studding-sails.
14 Main-lower-studding-sails.
15 Fore-top-mast-studding-sails.
16 Main-top-mast-studding-sails.
17 Fore-top-gallant-studding-sails.
18 Main-top-gallant-studding-sails.
19 Fore-sheets.
20 „ tacks.
21 „ leech-lines.
22 „ bunt-lines.
23 „ bow-lines.
24 Fore-bow-line-bridles.
25 Main-sheets.
26 „ tacks.
27 „ leech-lines.
28 „ bunt-lines.
29 „ bow-lines.
30 „ bow-line-bridles.
31 „ Fore-top-sail-bunt-lines.
32 Fore-top-sail-bow-lines.
33 „ „ bow-line-bridles.
34 Main-top-sail-bunt-lines.
35 „ „ bow-lines.
36 „ „ bow-line-bridles.
37 Mizen-top-sail-bunt-lines.
38 „ „ bow-lines.
39 „ „ bow-line-bridles.
40 Fore-top-gallant-bunt-lines.
41 „ „ bow-lines.
42 „ „ bow-line-bridles.
43 Main-top-gallant-bunt-lines.
44 „ „ bow-lines.
45 „ „ bow-line-bridles.
46 Mizen-top-gallant-bow-lines.